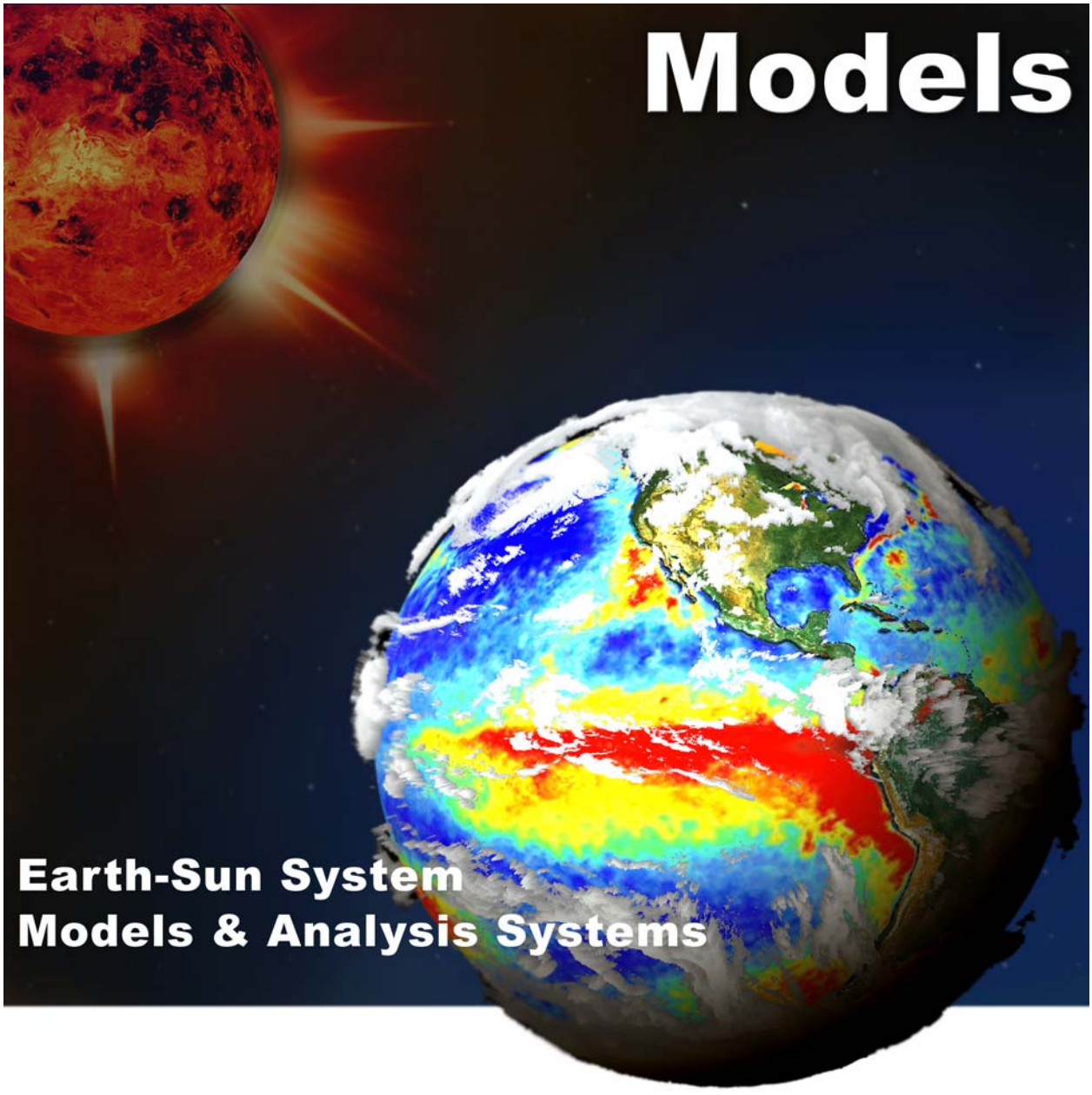

Working Draft

Version 6.0 - April 2007

Purpose Statement

This booklet provides reference information about Earth Science models with a NASA affiliation. For the purposes of this booklet, a NASA affiliation is considered to be either a history of NASA funding or use of NASA science products.

Models in the booklet are categorized as "ESMF" (The Earth System Modeling Framework) or "other NASA-affiliated". These categories are further divided into NASA-led and partner-led subcategories. ESMF is a significant mutiagency effort (funded in part by NASA) to create a modeling framework that enhances interoperability among various Earth system models.

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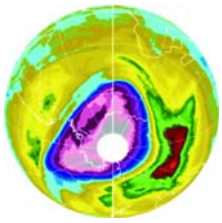
The NASA Vision
To improve life here,
To extend life to there,
To find life beyond.
The NASA Mission
To understand and protect our home planet,
To explore the universe and search for life,
To inspire the next generation of explorers...
as only NASA Can
www.nasa.gov

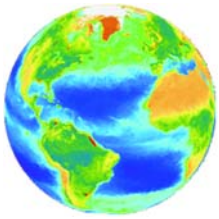
Science Mission Directorate
Earth Science Division

Focus Areas

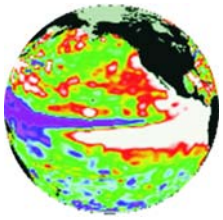
The NASA Earth Science Division seeks to develop a scientific understanding of the Earth-Sun system and its response to natural and human-induced changes to enable improved prediction of climate, weather, and natural hazards for present and future generations.



Atmospheric Composition

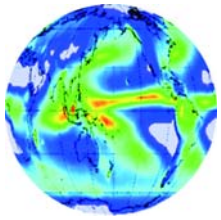


Carbon Cycle & Ecosystems

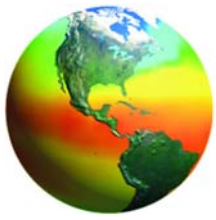


Climate Variability & Change

Earth Surface & Interior



Water & Energy Cycle



Weather

Sun Solar System

http://science.hq.nasa.gov/strategy/roadmaps/

Research Strategy

NASA's Earth Science Division is developing a scientific understanding of the Earth-Sun interactions and responses to natural and human-induced changes to enable improved prediction capability for climate, weather, and natural hazards. The Earth Science Division has an end-to-end strategy to ensure that all the information, understanding, and capabilities derived from its research program achieve maximum usefulness for the scientific and decision-making communities. Increasing our knowledge of the Earth system is the goal of the Earth Science Division's Research Program.

The Earth Science Division has defined its research strategy around a hierarchy of scientific questions. At the highest level, the Earth Science Division is attempting to provide an answer to one overarching question:

How is the Earth changing and what are the consequences for life on Earth?

The magnitude and scope of this question are too large to allow a simple answer, requiring a lower tier of questions that provide the conceptual approach that the Earth-Sun System Division is taking to improve our knowledge of the Earth system:

Variability: How is the global system changing?

Forcing: What are the primary forcings of the Earth system?

Response: How does the Earth system respond to natural and human-induced changes?

Consequence: What are the consequences of change in the Earth system for human civilization?

Prediction: How will the Earth system change in the future, and how can we improve predictions through advances in remote sensing observations, data assimilation and modelling?

Specific Science Questions

Variability	Forcing	Response	Consequence	Prediction
Precipitation, evaporation & cycling of water changing?	Atmospheric constituents & solar radiation on climate?	Clouds & surface hydrological processes on climate?	Weather variation related to climate variation?	Weather forecasting improve-ment?
Global ocean circulation varying ?	Changes in land cover & land use?	Ecosystems, land cover and biogeo-chemical cycles?	Consequences of land cover & land use change?	Improve predic-tion of climate variability and change?
Global ecosystems changing?	Motions of the Earth and the Earth's interior trans-formation?	Changes in global ocean circulation?	Coastal region impacts?	Ozone, climate and air quality impacts of atmospheric composition?
Atmospheric compostition changing?		Atmospheric trace constituent responses?	Regional air quality impacts?	Carbon cycle and ecosys-tem change?
Ice cover mass changing?		Sea level affected by Earth system changes?		Change in water cycle dynamics?
Earth surface transforma-tion?				Predict and miti-gate natural hazards from Earth surface change?

Applications of National Priority


Agricultural Efficiency


Air Quality


Aviation


Carbon Management


Coastal Management


Ecological Forecasting


Disaster Management


Energy Management


Homeland Security

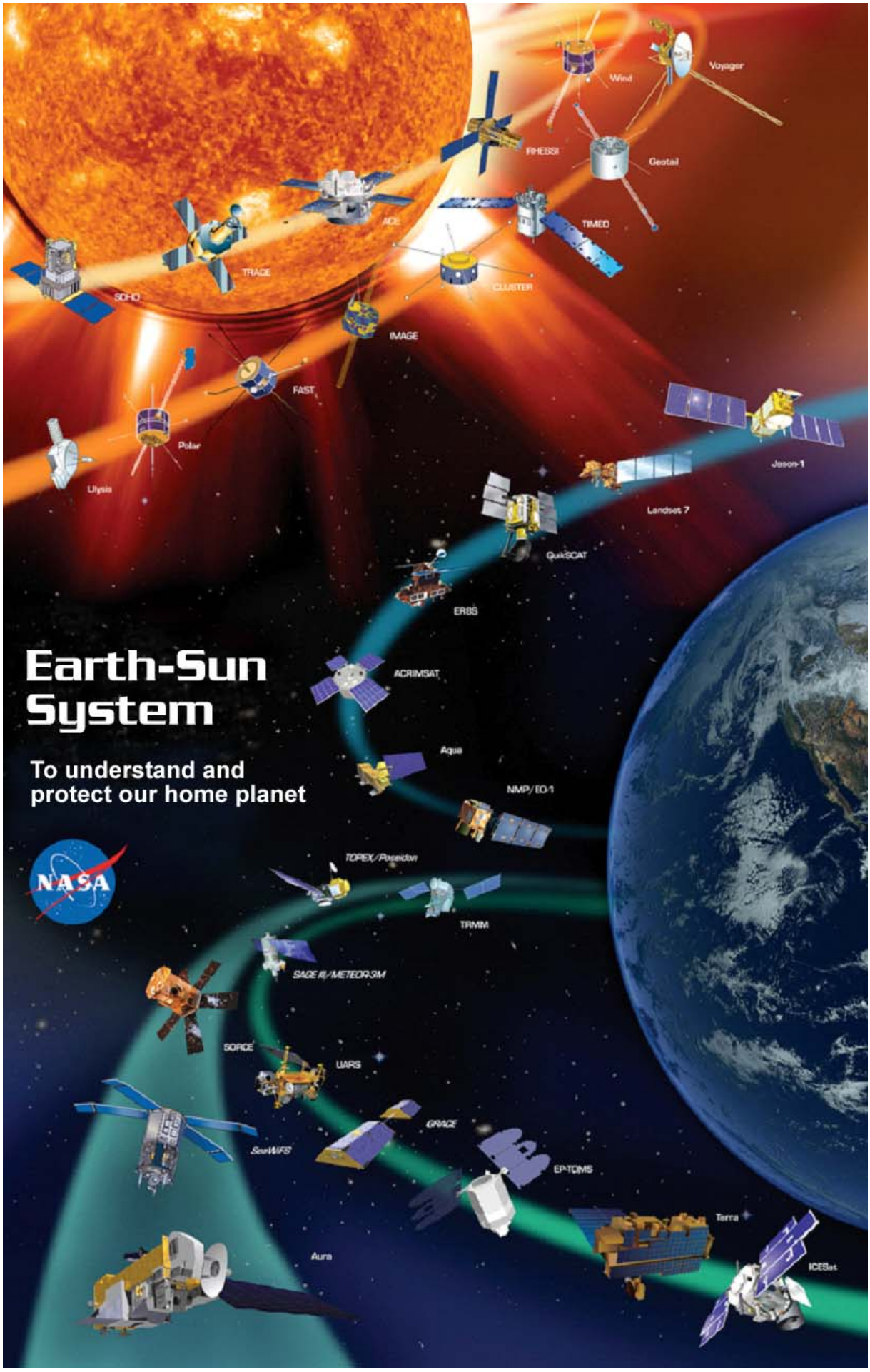

Invasive Species


Public Health

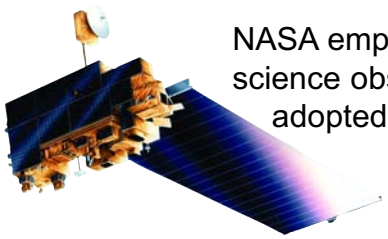

Water Management

The NASA Applied Sciences Program mission is to expand and accelerate the realization of economic and societal benefits from Earth science, information, and technology. The overarching goal is to bridge the gap between Earth science research results and the adoption of observations and prediction capabilities for reliable and sustained use in decision support.

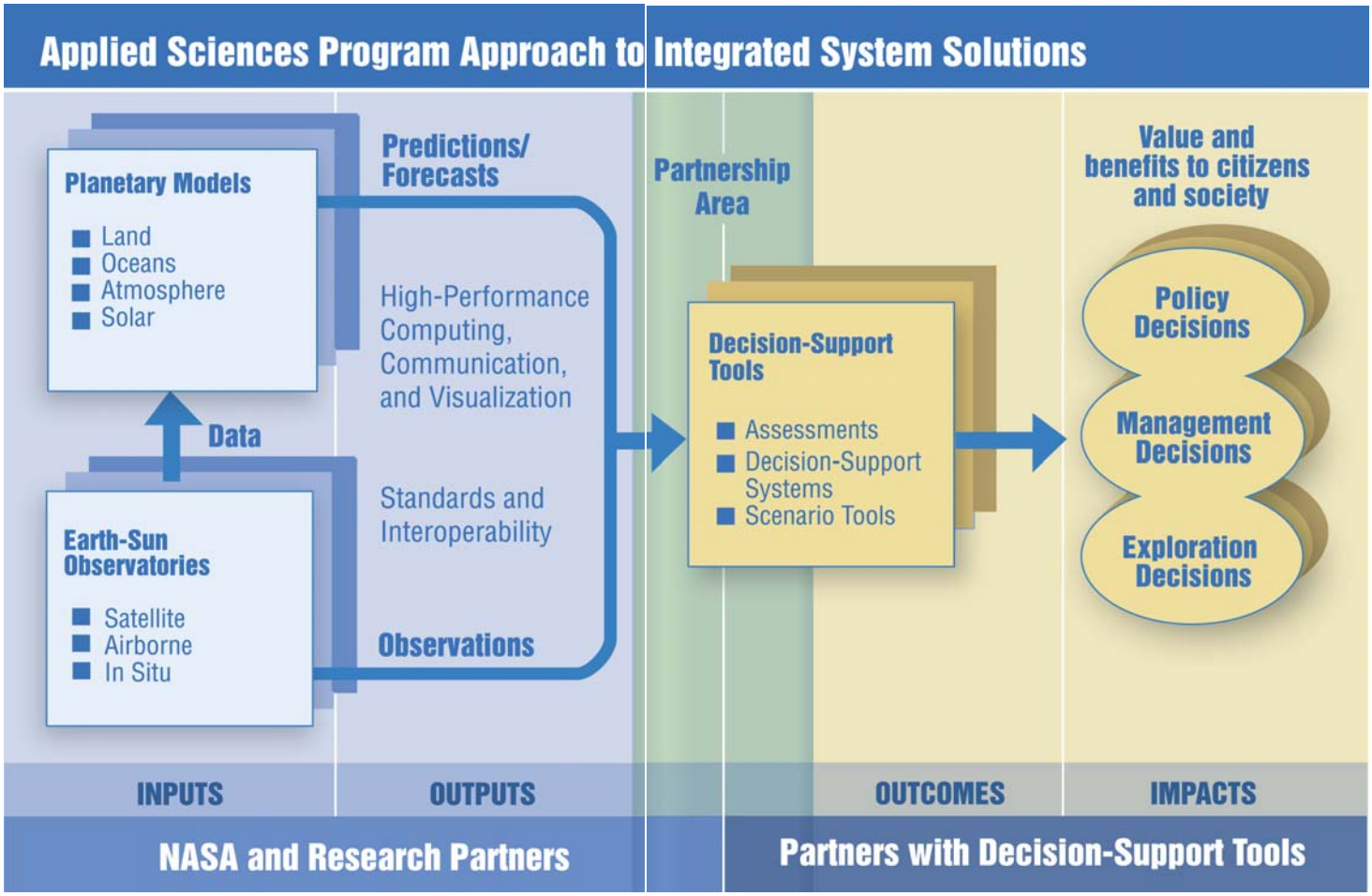
http://www.asd.ssc.nasa.gov/apps.aspx


Earth-Sun System
To understand and protect our home planet
NASA
Voyager
Wind
RHESSI
Geotail
ACE
TIMED
TRACE
SOHO
CLUSTER
IMAGE
FAST
Polar
Ulysis
Jason-1
Landsat 7
QuikSCAT
ERBS
ACRIMSAT
Aqua
NMP/EO-1
TOPEX/Poseidon
TRMM
SAGE III/METEOR-3M
SORCE
UARS
SeaWiFS
GRACE
EP-TOMS
Terra
Aura
ICESat

Integrated System Solutions Architecture



NASA employs a systems engineering approach to bridge the gap between Earth science observation systems and models. The data and prediction capabilities are adopted for reliable and sustained use in decision support.



http://science.hq.nasa.gov/earth-sun/applications/index.html

Earth System Modeling Framework Overview

• Over the last few years, the need for software infrastructure for Earth system modeling has grown increasingly apparent. Models and the computational platforms that they run on have become extremely complex, leading to excessive time and resources dedicated to solving computational rather than scientific problems.

• The Earth System Modeling Framework (ESMF) collaboration, which consists of Earth scientists and computational experts from major U.S. Earth modeling centers, is developing a robust, flexible set of software tools to enhance ease of use, performance portability, interoperability, and reuse in climate,numerical weather prediction, and data assimilation applications.

  • The ESMF will allow diverse scientific groups to leverage common software to solve routine computational problems such as efficient data communication, model component coupling and sequencing, time management, and parameter specification.
  • In an open dialogue with the broader community, the collaboration will also develop a software interface specification so that groups working at different institutions and in different disciplines can generate interoperable software components.

• The ESMF project is funded by the NASA Earth ScienceTechnology Office (ESTO) Computational Project under the Cooperative Agreement Notice (CAN) entitled: Increasing Interoperability and Performance of Grand Challenge Applications in the Earth, Space, Life and Microgravity Sciences. Funding began February 2002 and will consist of $10 million over three years.

http://www.esmf.ucar.edu

Earth System Modeling Framework Models

NASA-Led

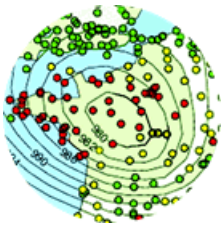
Partner-Led

GEOS-5 GSI Atmospheric Analysis

Purpose:
The atmospheric analysis component blends irregularly distributed (in space and time) observations with a regularly gridded model background state to produce a regularly gridded analysis state. This component encompasses the following tasks: (i) converts the gridded background state (forecast model variables) into an analysis background state, (ii) applies appropriate quality control procedures to the input observation streams (i.e. conventional, radiance data), (iii) computes (and saves with associated quality flags) observation-minus-forecast residuals (O-F), (iv) generates analysis increments from O-F using the GMAO general circulation model (GCM) plus GSI algorithm, (v) converts the analysis state back to a gridded state in GCM state variables.

INPUTS

- AMSU-A / AIRABRAD: AMSU-A Calibrated, Geolocated Radiances
- Conventional / Aircraft Flight Level Data
- MODIS / Atmospheric Motion Vectors
- GOES Imager / Atmospheric Motion Vectors
- HIRS / Radiances
- GOES Sounder / Radiances
- Conventional / Rawindsondes
- Conventional / Ship and Buoy Wind, Temp
- TOMS / TOMS: Ozone
- GMAO Atmosphere / Humidity
- GMAO Atmosphere / Meridional wind component
- GMAO Atmosphere / Ozone
- GMAO Atmosphere / Pressure
- GMAO Atmosphere / Temperature
- GMAO Atmosphere / Zonal wind component



Atmospheric Analysis

OUTPUTS

- Atmospheric temperature
- Atmospheric pressure
- Humidity
- Wind velocity

Model Platforms
- GSFC SGI Origin 3000 (Daley)
- GSFC Compaq (Halem)

Program Size: Approx. 150,000 lines
Run Time: Approx 5 min. on Halem platform/32pe, at 200km horizontal resolution, 32 levels
Resolution
Temporal: 6-hourly data-ingest and analysis cycle
Vertical: 64 levels (variable)
Horizontal: 0.5 degree (variable)
Range
Temporal: 1979 to present
Vertical: surface to mesosphere
Horizontal: global

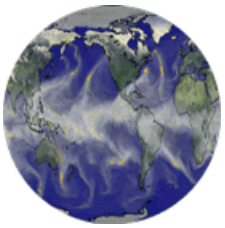
Access to model product: GSFC Distributed Active Archive Center (DAAC): http://daac.gsfc.nasa.gov/
Validation: Prototype: Wu et al. (2002), Monthly Weather Review
Config Control: GMAO tag #: gmao-gsi_1_0beta2
POC: Ronald Gelaro
Affiliation: NASA Global Modeling and Assimilation Office
Email Address: ron.gelaro@nasa.gov
Phone #: 301-614-6179
Funding: NASA Civil Servant
Contract #: GMAO core funded
Contract Name:
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: Yes
Website: TBD
Model Partners
- NOAA/NWS/NCEP/EMC

GEOS-5 AGCM

Purpose:
A Unified atmospheric model intended for use in a wide range of applications, including numerical weather prediction, data assimilation, seasonal forecasting, climate prediction, atmospheric chemistry studies, atmosphere land interactions, and coupled ocean-atmosphere modeling.

INPUTS

- HALOE / UARS HALOE Level 3AT Daily Time Ordered Data
- GSFC GOCART / 3-D distribution of each aerosol type
- GSFC GOCART / Absorption
- GSFC GOCART / Aerosol particle size
- GMAO Atmospheric Analysis / Atmospheric pressure
- GMAO Atmospheric Analysis / Atmospheric temperature
- GSFC GOCART / Column burden of individual aerosol species
- GSFC GOCART / Dust emission
- GMAO Atmospheric Analysis / Humidity
- GSFC GOCART / Individual aerosol concentration
- GSFC GOCART / Optical thickness of individual and total aerosols
- GSFC Catchment LSM / Radiation flux
- GSFC GOCART / Radiative forcing
- GMAO Ocean / Sea surface temperature
- GSFC GOCART / Sea-salt emission
- GSFC Catchment LSM / Sensible heat flux
- GSFC GOCART / Single scattering albedo
- GSFC Catchment LSM / Snow depth
- GSFC Catchment LSM / Soil moisture
- GSFC Catchment LSM / Surface evaporation
- GSFC Catchment LSM / surface radiation budget
- GSFC Catchment LSM / Surface temperature
- GSFC GOCART / Total aerosol concentration
- GSFC Catchment LSM / Water balance
- GMAO Atmospheric Analysis / Wind velocity



Atmosphere Model

OUTPUTS

- Dust emission
- Optical thickness of individual and total aerosols
- Column burden of individual aerosol species
- Total aerosol concentration
- Individual aerosol concentration
- 3-D distribution of each aerosol type
- Aerosol particle size
- Absorption
- Single scattering albedo
- Heating / Cooling Rates
- Surface geopotential
- Atmospheric temperature
- Atmospheric pressure
- Precipitation rate
- Total precipital water
- Wind surface stress
- Geopotential height
- Humidity
- Friction velocity
- Boundary layer height
- Cloud cover
- Cloud optical depth
- Wind velocity change rate
- Humidity change rate
- Eddy diffusivity
- Cloud mass flux
- Ozone concentration
- Atmospheric temperature change rate
- Wind velocity
- Surface heat and moisture fluxes

Model Platforms
- HP Compaq
Program Size: 3.2 MBytes
Run Time: 6 hours
Resolution
Temporal: 30 min
Vertical: 55 layers
Horizontal: adjustable from 50km to 200km
Range
Temporal: days to decades
Vertical: surface to 60 km
Horizontal: Global

Access to model product:
http://gmao.gsfc.nasa.gov/ OR contact POC

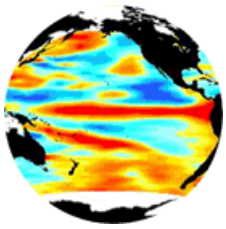
Validation: http://gmao.gsfc.nasa.gov/
Config Control: G-Forge at sourcemotel.gsfc.nasa.gov
POC: Max J. Suarez
Affiliation: GMAO
Email Address: max.j.suarez@nasa.gov
Phone #: 301 614 5292
Funding: NASA ESE
Contract #: RTOP-621-85-01
Contract Name:
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: Yes
Website: http://gmao.gsfc.nasa.gov/
Model Partners
- GEST

GMAO Ocean Analysis

Purpose:
Ocean analyses are primarily conducted for initialization of coupled seasonal-to-interannual forecasts, but also to make a best estimate of the ocean state for climate diagnostic purposes.

INPUTS

- Surface momentum, heat flux and fresh water forcing products
- AVHRR/3 /
- Argo / Salinity profile
- Moored data / Temperature
- Argo / Temperature profile
- XBT / Temperature profile
- CTD / Temperature profile
- GMAO Ocean / 3-D ocean salinity field
- GMAO Ocean / 3-D ocean temperature field
- GMAO Ocean / 3-D ocean velocity components
- GMAO Ocean / Sea surface height



Ocean Data Assimilation System

OUTPUTS

- 3-D ocean temperature field
- 3-D ocean salinity field
- 3-D ocean velocity components
- Sea surface height

Model Platforms
- HP Compaq
Program Size: 7MB
Run Time: 1.5 hours for OI assimilation on 64 PEs
Resolution
Temporal: Products are generally monthly means; but higher resolution products are also available
Vertical: 27 layers for V4, 34 layers for V5; resolution is spatially variable
Horizontal: 1/3 deg. latitude X 5/8 deg. longitude
Range
Temporal: 1993 to present, monthly averages
Vertical: surface to 1500m depth
Horizontal: 90S - 72N

Access to model product: please contact the model Point of Contact
Validation: Sun, C., M.M. Rienecker, A.Rosati, M. Harrison, A. Wittenberg, C.L. Keppenne, J.P. Jacob, R.M. Kovach, 2006: Comparison and sensitivity of ODASI ocean analyses in the tropical Pacific. Mon. Wea. Rev. (in press)
Keppenne, C.L., and M.M. Rienecker, 2003: Assimilation of temperature into an isopycnal ocean general circulation model using a parallel Ensemble Kalman Filter, J. Marine Syst., 40-41: 363-380.
Weather Review, V130, 2951-2964, 2002.
Config Control: V4
POC: Michele Rienecker
Affiliation: Code 610.1, NASA/Goddard Space Flight Center
Email Address: Michele.Rienecker@nasa.gov
Phone #: 301-614-6142
Funding: NASA
Contract #: WBS 802678.02.12
Contract Name:
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: Yes
Website: http://gmao.gsfc.nasa.gov/research/ocean/
Model Partners: SAIC, George Mason University

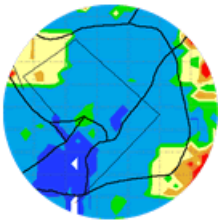
Notes: Multivariate Optimal Interpolation (MVOI) is referenced in: Borovikov, A.Y., M.M. Rienecker, C.L. Keppenne, and G.C. Johnson, 2005: Multivariate error covariance estimates by Monte-Carlo simulation for assimilation studies in the North Pacific, Mon. Wea. Rev., 133, 2310-2334.

GSFC Global LIS

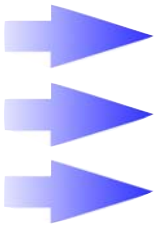
Purpose:
The Land Information System (LIS; Kumar et.al. 2006; Peters-Lidardet al. 2004) is a high performance Land Data Assimilation System (LDAS) that unifies and extends the capabilities of the ¼ degree Global LDAS (Rodell et al. 2004) and the 1/8th degree North American LDAS (NLDAS; Mitchell et al. 2004) to determine water and energy states (e.g. soil moisture, snow) and fluxes (e.g. evaporation, transpiration, runoff) at 1km and finer spatial resolutions, and at one-hour and finer temporal resolutions. LIS consists of several community land surface models, run offline using observationally- based precipitation, radiation and meteorological inputs and surface parameters. The 1km capability of LIS allows it to take advantage of the latest EOS-era observations, such as the MODIS leaf area index, snow cover and surface temperature, at their full resolution. LIS features a high performance and flexible design, provides infrastructure for data integration and assimilation, and operates an ensemble of land surface models for application over user-specified regional or global domains.

INPUTS

- Near surface air temperature
- Near surface CO2 concentration
- Near surface specific humidity
- Near surface wind
- Rainfall
- Surface incident shortwave and longwave radiation
- Surface pressure
- AVHRR / Land Cover Type
- AVHRR / Leaf Area Index
- MODIS / MOD09: Surface Reflectance
- MODIS / MOD10: Snow Cover
- MODIS / MOD11: Land Surface Temperature and Emissivity
- MODIS / MOD12: Land Cover Type
- MODIS / MOD15: Leaf Area Index and Fraction of Photosynthetically Active Radiation
- GOES Imager / Surface Radiation Budget
- NCEP Analysis / All model inputs listed below
- NCEP Atmosphere / All model inputs listed below
- GEOS-4 AGCM / All model inputs listed below
- AGRMET / Surface incident shortwave and long wave radiation



Land Surface Modeling System



OUTPUTS

- Sensible heat flux
- Soil moisture
- Surface temperature
- Radiation flux
- Snow depth
- Water balance
- Surface radiation budget
- Energy balance
- Runoff
- Soil temperature
- Snow water equivalent
- Latent heat flux
- Ground heat flux
- Evapotranspiration
- Evaporation
- Transpiration
- Infiltration
- Baseflow
- Surface albedo
- Soil wetness
- Root zone soil moisture

Model Platforms
- SGI IRIX64 6.5
- SGI Altix
- HP/Compaq alpha
- Mac OS
- Linux PC (Intel/AMD based)
- IBM SP2

Program Size: 9MB
Run Time: Depends on resolution/temporal range: seconds to days
Resolution
Temporal: Ranges from 1 second to 3600 seconds
Vertical: Ranges from 5cm to 1 m (thickness of soil layers)
Horizontal: Ranges from 2x2.5 degree to 1 km
Range
Temporal: Ranges from 1 day- years or more
Vertical: Ranges from 1 to 10 m (depth in soil)
Horizontal: Ranges from regional up to 0-360 degrees Longitude,
60S-90N degrees Latitude

Access to model product: please reference http://lis.gsfc.nasa.gov
Validation: N/A
Config Control: Version 4.2

POC: Dr. Christa Peters-Lidard
Affiliation: NASA/GSFC Hydrological Sciences Branch
Email Address: christa.peters@nasa.gov
Phone #: 301-614-5811
Funding: NASA
Contract #: GSFC-CT-2
Contract Name:
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: Yes
Website: http://lis.gsfc.nasa.gov
Model Partners
- NASA Goddard Space Flight Center Hydrological Sciences Branch
- NOAA National Centers for Environmental Prediction
- Air Force Weather Agency
- NASA Global Modeling and Assimilation Office
- United States Department of Agriculture
- Center for Research in Environment and Water
- Center for Ocean-Land Atmospheric Studies
- Princeton University Department of Civil and Environmental Engineering

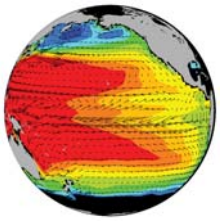
Notes: Future version of the Land Information System with added functionality will be available 9/2004. LIS version 2.3 was released in December of 2003. nformation Last Updated: 3/17/2004

ECCO OSE

Purpose:
Overall goal is to bring ocean state estimation from its experimental status to that of a practical and quasi operational tool for studying large-scale ocean dynamics, designing observational strategies, and examining the ocean's role in climate variability. Our technical goal is the sustained production and evaluation of continuing three-dimensional estimates of the global state of the ocean in near-real time in support of programs such as GODAE and CLIVAR. The main task is to bring together a global GCM with existing global data streams - including TOPEX/POSEIDON and JASON altimeter observations and in situ hydrographic and flow measurements such as what will be available from the ARGO program - to obtain the best possible estimate of the time evolving ocean circulation and related uncertainties.

INPUTS

- AVHRR / AVHRR: Sea Surface Temperature
- CTD / CTD Temperature
- Floats / Floats Temperature
- JMR / Jason: Sea Surface Height
- Moored data / Moorings Temperature
- SeaWinds / SeaWinds: Wind Speed and Direction
- TOPEX/Poseidon / TOPEX: Sea Surface Height
- XBT / XBT Temperature
- NCEP Analysis / All model inputs listed below



Ocean State Estimation

OUTPUTS

- 3-D ocean temperature field
- 3-D ocean salinity field
- 3-D ocean velocity components
- Sea surface height
- Ocean bottom pressure
- 3-D mixing tensor

Model Platforms
- SGI Origin 2000
Program Size: 19GB runtime memory, 40000 lines of code
Run Time: 6hours on 64cpu SGI Origin 2000 for 1-model year integration
Resolution
Temporal: 1hour, 12hour, 10day, 30day
Vertical: 10m~400m; 10m~500m
Horizontal: 1-deg to 1/3-deg; 1-deg; 2-deg
Range
Temporal: 1993 to present; 1992 to 2002
Vertical: surface to bottom of ocean
Horizontal: 78S to 78N

Access to model product:
http://www.ecco-group.org; http://ecco.jpl.nasa.gov/las
Validation: See http://www.ecco-group.org/publications.html
Config Control: ECCO-1; ECCO-2
POC: Ichiro Fukumori
Affiliation: Jet Propulsion Laboratory
Email Address: fukumori@jpl.nasa.gov
Phone #: 818-354-6965
Funding: NASA, National Oceanographic Partnership Program (NOPP)
Contract #: 622.48.24, 622.50.02, 622.50.01, 622.48.35
Contract Name:
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: No
Website: www.ecco-group.org
Model Partners
- Massachusetts Institute of Technology
- Scripps Institution of Oceanography, Univ. California San Diego
- Jet Propulsion Laboratory, California Institute of Technology

Notes:

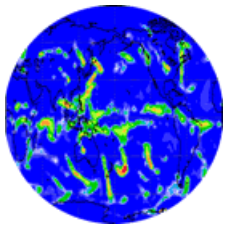
Information Last Updated: 8/30/2004

GFDL FMS B-grid Atmosphere

Purpose:
B-Grid is a hydrostatic finite difference model on a staggered Arakawa B grid and hybrid sigma/pressure vertical coordinate. Its purpose is to serve as an atmospheric general circulation model, which can be used as a component of coupled earth-system models.

INPUTS

- Aerosol distribution
- Landcover Type
- Sea ice concentration
- Sea surface temperature
- Soil description
- Solar flux
- Vegetation description



Atmospheric Science and Climate Research

OUTPUTS

- Column burden of individual aerosol species
- Individual aerosol concentration
- Absorption
- Surface geopotential
- Atmospheric temperature
- Atmospheric pressure
- Precipitation rate
- Total precipital water
- Wind surface stress
- Geopotential height
- Humidity
- Cloud cover
- Wind velocity
- Surface heat and moisture fluxes
- Water vapor mixing ratio
- stratospheric ozone and related trace gases

Model Platforms
- SGI IRIX64
- SGI Altix
- Beowulf type cluster
Program Size: 220,000 lines of code
Run Time: 4.1 model years/day (45 pes, Irix), 5.2 years/day (45 pes, Altix), 1.8 years/day (30pes, Beowulf)
Resolution
Temporal: 30 min
Vertical:24 levels (variable resolution)
Horizontal: 2.5 long x 2 lat
Range
Temporal: 1860-2300
Vertical:surface - 3.5 hPa
Horizontal: global

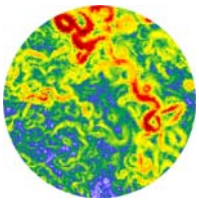
Access to model product:
http://nomads.gfdl.noaa.gov (on or about 10 December 2004, all IPCC PCMDI data will be available)
Validation: Geophysical Fluid Dynamics Laboratory Global Atmospheiric Model Development Team (2004, J. Climate), in press.

Config Control: am2p13
POC: Venkatramani Balaji
Affiliation: Geophysical Fluid Dynamics Laboratory
Email Address: vb@gfdl.noaa.gov, balaji@princeton.edu
Phone #: 609-452-6516
Funding: NASA (ESMF)
Contract #: CAN-00-OES-01
Contract Name: Earth System Modeling Framework (ESMF)
Past Funding:
Currently Use NASA Data Products as Input: No
Being Investigated for Use of NASA Data Products as Input: No
Website: http://www.gfdl.noaa.gov/~fms
Model Partners:
Notes:For forecast (30/90 days, seasonal, El Nino/La Nina) purposes, the atmosphere-only model uses sea surface temperature values for the previous month and persists the monthly mean anomalies for the month. The run is done over twelve months, with the first month discarded. A reference for the datasets used is: Caron, Hack, Hurrell, Rosinski, and Shea; "A New Sea Surface Temperature and Sea Ice Boundary Dataset for the NCAR Community Atmospheric Model."

GFDL FMS HIM Ocean

Purpose:

INPUTS



Oceanographic and Climate Research

OUTPUTS

----WAITING ON INPUT----

Model Platforms

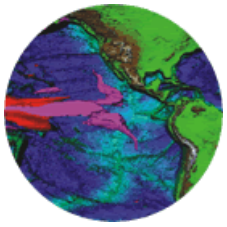
Access to model product:

GFDL MOM4 Ocean

Purpose:
The Modular Ocean Model (MOM) is a numerical representation of the ocean's hydrostatic primitive equations, and it is designed primarily as a tool for studying the global ocean climate system. It is developed and supported by researchers at NOAA's Geophysical Fluid Dynamics Laboratory (GFDL), with contributions also provided by researchers worldwide.

INPUTS

• chlorophyll concentrations from the SeaWiFS satellite for the period 1999-2001
• NOAA National Oceanographic Data Center (NODC)



Ocean Circulation Model

OUTPUTS

• 3-D ocean temperature field
• 3-D ocean salinity field
• 3-D ocean velocity components
• Sea surface height
• Sea surface temperature
• Ocean bottom pressure
• Sea surface salinity
• Sea salt flux
• Ocean surface current

Model Platforms
- SGI IRIX64
- Intel Fotran Compiler
- IBM
- NEC
Program Size: source code: 7.5 megabytes
Run Time: simplest test case, 6 processors: 4.7 sec for 10 model days
Resolution
Temporal: varies, typically from 7200 to 10800 seconds
Vertical: varies, up to 50 vertical levels
Horizontal: varies between 1 and 3 degress
Range
Temporal: from 1 days to hundreds of years
Vertical: up to 5500 meter depth
Horizontal: global

Access to model product: https://fms.gfdl.noaa.gov/account/register.php
Validation: MOM4 has been used in GFDL IPCC coupled runs and other institutions
Config Control: latest release is mom4p0c (as of 9/17/2004)
POC: Giang Nong
Affiliation: Geophysical Fluid Dynamics Laboratory
Email Address: Giang.Nong@noaa.gov
Phone #: 609-452-6578
Funding: NOAA, NASA (ESMF)
Contract #: CAN-00-OES-01
Contract Name: Earth System Modeling Framework (ESMF)
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: No
Website: http://www.gfdl.noaa.gov/~fms
Model Partners

Notes: MOM4 is still in development. A new release of MOM4 (code, data, results) to the public is scheduled once every few months. Please check the MOM4 user's guide (http://www.gfdl.noaa.gov/~fms) for the latest development of MOM4.

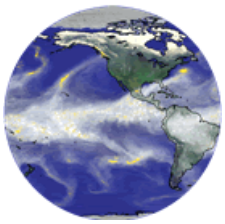
Information Last Updated: 10/19/2004

GMU Ocean

Purpose: The Poseidon Quasi-isopycnal Ocean Model provides 3-D ocean salinity field, temperature field, 3-D ocean velocity components and sea surface height predictions for use in global ocean state seasonal forecasts, ocean data assimilation, and ocean process studies for short-term climate variability..

INPUTS

- ocean bottom topography
- Surface momentum, heat flux and fresh water forcing products



Ocean Model

OUTPUTS

- 3-D ocean temperature field
- 3-D ocean salinity field
- 3-D ocean velocity components
- Sea surface height

Model Platforms
- HP Compaq
Program Size: 5.4MB
Run Time: 20 mins wall clock for 1 month simulation on 64 PE's for V4
Resolution
Temporal: monthly means
Vertical: 27 layers for V4, 34 layers for V5
Horizontal: 1/3 deg. latitude X 5/8 deg. longitude
Range
Temporal: 1981 to present
Vertical: upper 1500 m for V4; full ocean depth for V5
Horizontal: South Pole to 72 deg. N

Access to model product: please contact the model Point of Contact.
Validation: Borovikov, A, M.M. Rienecker and P.S. Schopf, J.
Climate, V14, 2624-2641, 2001
Config Control: V4 and V5, the latter with full bottom topography
POC: Professor Paul Schopf
Affiliation: NASA
Email Address: pschopf@gmu.edu
Phone #: 703-993-3609
Funding: NASA
Contract #: RTOP 622-24-47
Contract Name:
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: Yes
Website:
http://nsipp.gsfc.nasa.gov/research/ocean/ocean_descrh tml

Model Partners
- George Mason University

Notes:

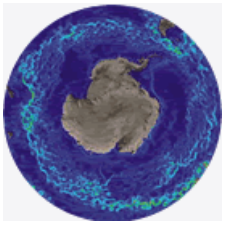
Information Last Updated: 10/18/2006

LANL CICE

Purpose: to represent the thermodynamic and dynamic effects of sea ice in global climate modeling systems, for both short- and long-term studies, and at low or high resolution

INPUTS

- Cloud fraction
- Near-surface air temperature
- Near-surface specific humidity
- Near-surface wind
- Precipitation
- Sea surface salinity
- Sea surface temperature
- Solar flux



Sea Ice Model

OUTPUTS

- Snow depth
- Sea ice area fraction
- Sea ice thickness
- Sea ice temperature
- Sea ice velocity
- Surface stresses
- Heat fluxes
- Fresh water fluxes
- Mass fluxes
- Sea ice internal stresses
- Sea ice deformation

Model Platforms
- Linux
- IRIX64
- AIX
- Unicos

Program Size: 17 MB including input files and documentation
Run Time: 1.5 min/simulated month for 3 degree global configuration
Resolution
Temporal: varies (typically 0.5 to 4 hours)
Vertical: varies (typically 4 layers ice + 1 layer snow)
Horizontal: varies (0.1 deg to 3 deg or more); includes multiple-category ice thickness distribution (subgrid)
Range
Temporal: unlimited
Vertical: unconstrained
Horizontal: global

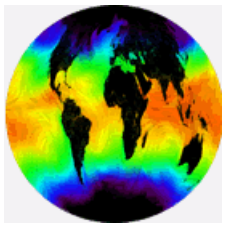
Access to model product: Source code available via the CICE website at http://climate.lanl.gov/Models/CICE/index.htm.
Validation: eg., Hunke and Ackley (J. Geophys. Res. 106, p 22,373, 2001). See also model documentation included with release and CCSM publications.
Config Control: CICE v3.1
POC: Elizabeth Hunke
Affiliation: Los Alamos National Laboratory
Email Address: eclare@lanl.gov
Phone #: 505-665-9852
Funding: NASA (ESMF)
Contract #: CAN-00-OES-01
Contract Name: Earth System Modeling Framework
Past Funding:
Currently Use NASA Data Products as Input: No
Being Investigated for Use of NASA Data Products as Input: No
Website: http://climate.lanl.gov/Models/CICE/index.htm
Model Partners

Notes: NASA data products used for model validation. Closely associated with sea ice component of NCAR Community Climate System Model (CCSM/CSIM).

LANL HYPOP

Purpose:

INPUTS



Hybrid Global Circulation Model

OUTPUTS

---WAITING ON INPUT---

Model Platforms

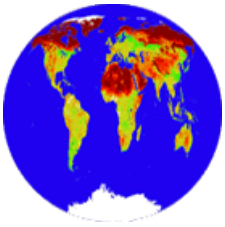
Access to model product:

LANL POP Ocean

Purpose: The POP model is used for simulating the global ocean circulation (particularly for use in climate system models), high-resolution eddy resolving simulations, and ocean biogeochemistry. POP is the ocean component of the Community Climate System Model (CCSM).

INPUTS

- Freshwater forcing products
- Ocean bottom topography
- Surface heat flux
- Surface incident longwave radiation
- Surface incident shortwave radiation
- Surface momentum
- LANL CICE / ice fields in coupled model
- NCAR CAM / Surface fields in coupled model



Global Ocean Circulation Model

OUTPUTS

- 3-D ocean temperature field
- 3-D ocean salinity field
- 3-D ocean velocity components
- Sea surface height
- Sea surface temperature
- 3-D mixing tensor
- Sea surface salinity
- Sea salt flux
- Sea ice melting flux
- Ocean surface current

Model Platforms

- AIX
- IRIX64
- OSF1
- Solaris
- Linux.pgi
- Linux.lahey

Program Size: Approx. 50,000 lines of code
Run Time: For 1-degree resolution: 10 simulated years/CPU
day on 16 processors of SGI Altix
Resolution
Temporal: Typically 1 hour
Vertical: Typically 40 vertical levels
Horizontal: Typically 1 degree (100 km)
Range
Temporal: 7 minutes to 1 hour
Vertical: Up to 40 vertical levels
Horizontal: 0.1 degree (10 km) to 1 degree (100 km)

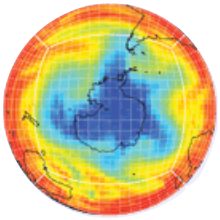
Access to model product: Personal contact ; also soon on Earth
System Grid (https://www.earthsystemgrid.org/).
Validation: Smith, RD, ME Maltrud, FO Bryan, MW Hecht, 2000:
Numerical simulation of the North Atlantic Ocean at 1/10 degrees.
J. Phys. Oceanogr. 30,1532-61.
Config Control: Version 2.0.1
POC: Phil Jones
Affiliation: LANL
Email Address: pwjones@lanl.gov
Phone #: 505-667-6387
Funding: DOE (CCPP, SciDAC), NASA (ESMF)
Contract #: CAN-00-OES-01
Contract Name: Earth System Modeling Framework
Past Funding:
Currently Use NASA Data Products as Input: No
Being Investigated for Use of NASA Data Products as Input: No
Website: http://climate.lanl.gov/Models/POP/index.htm
Model Partners
- NCAR
- Naval Postgraduate School (NPS)

Notes:

MITgcm Atmosphere

Purpose:

INPUTS



Atmosphere Fluid Model

OUTPUTS

----WAITING ON INPUT----

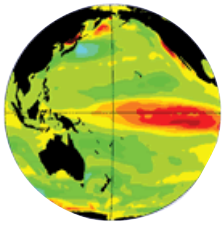
Model Platforms

Access to model product:

MITgcm Ocean

Purpose:

INPUTS



Ocean Fluid Model

OUTPUTS

----WAITING ON INPUT----

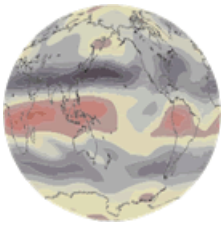
Model Platforms

Access to model product:

NCAR CAM

Purpose:

INPUTS



Global Atmosphere Model

OUTPUTS

----WAITING ON INPUT----

Model Platforms

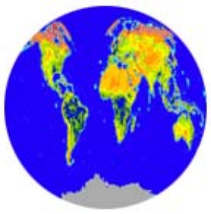
Access to model product:

NCAR CLM

Purpose: The Community Land Model is designed for coupling to atmospheric numerical models to study land-atmosphere interactions. It simulates energy, moisture, and momentum fluxes between land and atmosphere, the hydrologic cycle, and soil temperature. It links photosynthesis, transpiration, and stomatal conductance and simulates the terrestrial carbon cycle and vegetation dynamics. The model has a river routing scheme to transport runoff to the oceans.

INPUTS

- Digital Elevation Model
- Meteorological forcing (from atmospheric model, or reanalysis, or obs network, etc.)
- Soil Hydraulic Properties
- Soil Physical properties
- vegetation and soil description
- MODIS / MOD 12Q1: Land Cover Classification
- MODIS / MOD15: Leaf Area Index and Fraction of Photosynthetically Active Radiation



Energy, Water, Carbon Fluxes

OUTPUTS

- Soil moisture
- Surface temperature
- Surface evaporation
- Surface albedo
- Surface roughness
- Surface temperature change rate
- Surface type
- Water balance
- Energy balance
- Runoff
- Soil Temperature
- Latent heat flux
- Ground heat flux
- Evapotranspiration
- Evaporation
- Transpiration
- Infiltration
- Land NPP
- Soil trace gas

Model Platforms

- IBM SP (AIX)
- CRAY X1 (Unicos)
- INTEL (Linux)
- NEC SX6 (Super-UX)

Program Size: 54,000 lines of code
Run Time: 1.2 seconds per day for a global 2.8 degree grid on bluesky (32 processors) at NCAR Resolution
Temporal: Time step depends on host atmospheric model, but is generally 20-30 minutes
Vertical: 10 soil layers to a depth of 3-4 meters
Horizontal: Global grid (e.g., 2.8 degrees), regional grid (e.g., 10 km), single point Range
Temporal: Past, present, future climates
Vertical: 10 soil layers to a depth of 3-4 meters
Horizontal: Single column to global grid

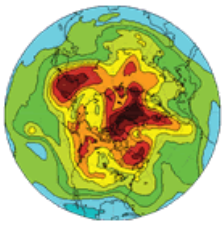
Access to model product: Community Climate System Model (CCSM) control runs can be found at: http://www.cgd.ucar.edu/csm/
Validation: A full list of publications is found at the CLM website
Config Control: Community Land Model (CLM 3.0)
POC: Sam Levis
Affiliation: National Center for Atmospheric Research
Email Address: slevis@ucar.edu
Phone #: 303-497-1627
Funding: NASA, NSS, DOE, others
Contract #: NASA ESMF, IDS, LCLUC, Terrestrial Ecology Programs
Contract Name:
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: No
Website: http://www.cgd.ucar.edu/tss/clm/
Model Partners
- CCSM Land Model Working Group
- LDAS, GLDAS

Notes:

NCEP Analysis

Purpose:

INPUTS



Weather and Seasonal

OUTPUTS

----WAITING ON INPUT----

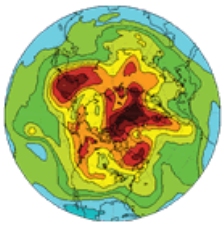
Model Platforms

Access to model product:

NCEP Atmosphere

Purpose:

INPUTS



Weather and Seasonal Predictions

OUTPUTS

----WAITING ON INPUT----

Model Platforms

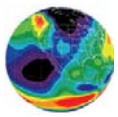
Access to model product:

UCLA AGCM

Purpose: This model is intended for research on numerical weather prediction and as a teaching tool on numerical methods and the general circulation of the atmosphere.

INPUTS

- analyzed/forecasted surface wind, SST and ice products
- Boundary condititions for source gases speci fied by WMO
- CO emission inventory
- ground saturation
- Landcover Type
- Near surface CO2 concentration
- NOx emission inventory
- Sea surface temperatures/sea ice concentra- tion
- skin temperature
- snow depth/cover
- solar flux
- topographic data (DEMs)
- vegetation and soil description
- SeaWinds / SeaWinds: Polar Sea Ice Grids



Finite Difference Global Atmosphere

OUTPUTS

- Single scattering albedo
- Radiative forcing
- Heating / Cooling Rates
- Surface geopotential
- Atmospheric temperature
- Sensible heat flux
- Atmospheric pressure
- Precipitation rate
- Total precipital water
- Soil moisture
- Wind surface stress
- Surface temperature
- Geopotential height
- Humidity
- Surface evaporation
- Radiation flux
- Surface albedo
- Surface roughness
- Boundary layer height
- Cloud cover
- Cloud optical depth
- Ozone concentration
- Surface type
- Wind velocity
- surface radiation budget
- Energy balance
- Soil Temperature
- Ground heat flux
- Evaporation
- Zonal wind
- Meridional wind
- Temperature
- Pressure
- Ozone
- Soil trace gas
- Surface values, fluxes, constituent amounts
- Sea surface temperature
- Surface heat and mois ture fluxes
- Water vapor mixing ratio
- Surface upward heat flux (air)
- Surface upward heat flux (water)
- full suite of middle atmosphere chemical species
- stratospheric ozone and related trace gases

Model Platforms

- SGI Origin 2000, 3000
- Cray YMP, T3D
- SUN Workstations
- HP Workstations, OSF, LINUX
- IBM SP2, SP3, Workstations

Program Size: More than 30,000 lines of code
Run Time: 34 sec / simulated day for 512 nodes on an SGI 3000
Resolution
Temporal: dynamics: 180 seconds, physics: 60 minute
Vertical: 1 mb, 15, 18, 29,32 levels
Horizontal: 2.4 x 3.0 degrees
Range
Temporal: dynamics 30-450 seconds, physics: 10-60 minutes
Vertical: 1.0 or 100 mb, 9 thru 32 levels
Horizontal: 1.0 thru 5.0 degrees

Access to model product: Access to model product: esm-a.atmos.ucla.edu/~vacs
Validation: Mechoso, C. R., J.-Y. Yu and A. Arakawa, 2000: "A Coupled GCM Pilgrimage: From Climate Catastrophe to ENSO Simulations."
Config Control: UCLA Model Version 7.2
POC: Professor Carlos Roberto Mechoso
Affiliation: University of California at Los Angeles
Email Address: mechoso@atmos.ucla.edu
Phone #: 310-825-3057
Funding: NASA, Earth System Modeling Framework (ESMF)
Contract #: CAN-00-OES-01
Contract Name:
Past Funding:
Currently Use NASA Data Products as Input: No
Being Investigated for Use of NASA Data Products as Input: No
Website: http://www.atmos.ucla.edu/~mechoso
Model Partners

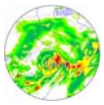
Notes: Validation paper featured in General Circulation Model Development: Past, Present and Future Proceedings of a Symposium in Honor of Professor Akio Arakawa. D. A. Randall. Ed., Academic Press, 539-575.

WRF

Purpose:
The Weather Research and Forecast (WRF) is a mesoscale forecast model and assimilation system designed to advance the understanding and prediction of mesoscale precipitation systems to promote ties between the research and operational forecasting communities. WRF is used particularly for treatment of convection and mesoscale precipitation. It is intended for applications with emphasis on horizontal grids of 1-10km. It is expected to replace existing forecast models such as the MM5 at the Pennsylvania State University/National Center for Atmospheric Research, the ETA model at the National Centers for Environmental Prediction, and the RUC system at the Forecast Systems Laboratory.

INPUTS

- Meteorological forcing
- Near surface air temperature
- Near surface wind
- SEA SURFACE TEMPERATURES
- skin temperature
- snow depth/cover
- Soil Hydraulic Properties
- Soil Physical properties
- Surface pressure
- topographic data (DEMs)
- vegetation and soil description
- Radiosonde / Atmospheric Variables
- Temperature Lidar / Temperature
- Air Temp & RH Probe / Temperature and RH profiles
- FSL LAPS / Atmosphere/Land
- WRF 3D VAR / Atmospheric Analyses
- RUC / Atmospheric/land variables
- NCEP Analysis / Atmospheric/land variables



Weather Research and Forecast Model

OUTPUTS

- Total aerosol concentration
- 3-D distribution of each aerosol type
- Absorption
- Single scattering albedo
- Radiative forcing
- Heating / Cooling Rates
- Surface geopotential
- Atmospheric temperature
- Sensible heat flux
- Atmospheric pressure
- Precipitation rate
- Total precipital water
- Soil moisture
- Wind surface stress
- Surface temperature
- Geopotential height
- Humidity
- Surface evaporation
- Radiation flux
- Surface albedo
- Friction velocity
- Surface roughness
- Boundary layer height
- Surface temperature change rate
- Snow depth
- Cloud cover
- Cloud optical depth
- Wind velocity change rate
- Humidity change rate
- Eddy diffusivity
- Cloud mass flux
- Atmospheric temperature change rate
- Surface type
- Wind velocity
- Water balance
- surface radiation budget
- Energy balance
- Runoff
- Soil Temperature
- Snow water equivalent
- Latent heat flux
- Ground heat flux
- Evapotranspiration
- Evaporation
- Transpiration
- Infiltration
- Land NPP
- Sea surface temperature
- Surface heat and moisture fluxes
- Water vapor mixing ratio
- Snowfall amount
- Momentum flux

Model Platforms

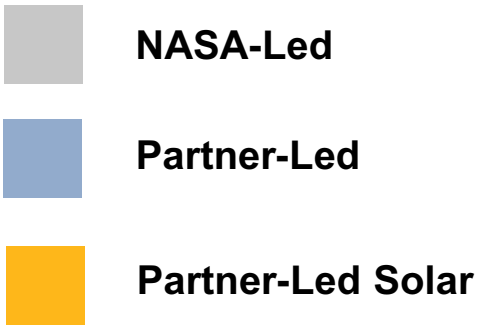
- IBM
- SUN
- Linux
- SGI
- Dec Alpha
- PC-Intel

Program Size: More than 100,000
Run Time: 1 hour for 48 hour simulation using parameters in note 1
Resolution
Temporal: Seconds to minutes
Vertical: 500 m
Horizontal: 1 to 150 km
Range
Temporal: hours to years
Vertical: 2 mb
Horizontal: Regional (1000's of km)

Access to model product: Available in standard binary output file. Others can be extracted via code modifications.
Validation: Multiple (http://wrf-model.org/documentation_main.html)
Config Control: Version WRF V2.0.3.1 (released November 2004)
POC: NCAR (http://box.mmm.ucar.edu/wrf/users/)
Affiliation: UCAR/NCAR
Email Address: wrfhelp@ucar.edu
Phone #: NA
Funding: Multiple Sources (NOAA, AWFA, NSF, NAVY, NASA)
Contract #: CAN-00-OES-01
Contract Name: Earth System Modeling Framework (ESMF)
Past Funding:
Currently Use NASA Data Products as Input: No
Being Investigated for Use of NASA Data Products as Input: Yes
Website: http://wrf-model.org/
Model Partners

Notes: 1. Run time given is for a simulation with single grid of dimension 150 x 150 x 28 [y,x,z] grid at 12 km horizontal resolution with a time step of 75 s on a Linux cluster configures with 38 Pentium III 1.0 GHz processors interconnected via a Myrinet fiber optic backbone.

NASA-Affiliated Earth-Sun Science Models & Analysis Systems

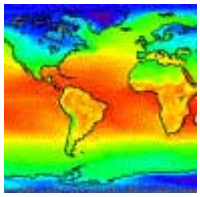


CASA

Purpose: Fluxes of all major biogenic "greenhouse" gases and reactive tropospheric gases are simulated using the NASA-CASA Model.

INPUTS

- MODIS / MOD12: Land Cover Type
- MODIS / MOD15: Leaf Area Index and Fraction of Photosynthetically Active Radiation
- NCEP GFS Analysis / All model inputs
- MODIS / MOD13: Vegetation Indices



Net Ecosystem Production

OUTPUTS

- Soil texture
- Soil water holding capacity
- Soil pH
- Predicted annual NPP
- Predicted fluxes of soil trace gases
- Predicted carbon storage
- Vegetation uptake

Model Platforms

- Unix
Program Size: 4 GB limit
Run Time: 8-12 hours
Resolution
Temporal: Monthly
Vertical: 0
Horizontal: 8 kilometer
Range
Temporal: 1982-2003
Vertical: 0
Horizontal: global

Access to model product:
http://geo.arc.nasa.gov/sge/casa/
Validation: http://geo.arc.nasa.gov/sge/casa/
Config Control: Current version V11
POC: Christopher Potter
Affiliation: NASA Ames
Email Address: cpotter@mail.arc.nasa.gov
Phone #: 650-604-6164
Funding: NASA OES
Contract #: 21-291-01-91
Contract Name:
Past Funding: 21-291-01-91
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: No
Website: http://geo.arc.nasa.gov/sge/casa/
Model Partners
- California State University

Notes:

CM4

Purpose: The comprehensive magnetic field models have been developed to describe the major field sources encountered in the quiet-time, near-Earth environment in a consistent manner so as to provide useful reference fields to the community.

Comprehensive Model of the Geomagnetic Field

INPUTS

- Coefficient file
- Universal time
- Spatial spherical or ellipsoidal (geodetic) coordinates
- Disturbance storm-time index (Dst)
- F10.7 solar radio flux value

OUTPUTS

- Magnetic field vectors in nT in local (North,East,Down) coordinate system of:
- Internal origin (core and crust)
- Magnetospheric primary and secondary (induced) origin
- Ionospheric primary and secondary origin
- Satellite altitude origin from in situ currents
- Current functions and current density vectors in local NED coordinate system
- Equivalent densities for induced magnetospheric and primary and induced ionospheric in A/m
- Current functions for induced magnetospheric and primary and induced ionospheric in kA
- Poloidal density for in situ currents at satellite altitude in nA/m^2

III) Spherical harmonic model coefficients for each source as a function of truncation level and time

Model Platforms: All platforms with Fortran f77 compilers
Program Size: 200 KB
Run Time: Depends on which field sources are desired,
but < 1 hr on a 1x1 degree grid for all sources
on a 1.6 GHz Opteron platform running Linux
Resolution -Temporal: 1hr for external/induced fields an about 2yrs for SV
Resolution -Vertical: Potential fields, see horizontal
Resolution -Horizontal: 600 km for internal, 1000 km for ionospheric, uniform magnetospheric field
Range -Temporal: 1 hr to decades
Range -Vertical: Surface to < 1500 km altitude, but fields from in situ currents are restricted to satellite sampling shells
Range -Horizontal: Entire sphere

Access to model product:
http://geodynamics.gsfc.nasa.gov/CM/
Validation: see Sabaka, T.J., Olsen, N. and M.E. Purucker, Geophys J. Int., 159, 521-547, doi: 10.1111/j.1365-246X.2004.02,421.x, 2004.
Config control: CM4
Currently Use NASA Products as Input: yes
Model Partners: Danish National Space Center
POC: Terence J. Sabaka
Affiliation: Planetary Geodynamics Laboratory, Code 698, NASA Goddard Space Flight Center
Email Address: sabaka@geomag.gsfc.nasa.gov
Phone: 301-614-6493
Website: http://geodynamics.gsfc.nasa.gov/CM/s

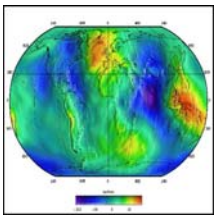
EGM-96

Goddard Atmospheric Chemistry and Transport Model

Purpose: EGM96 is a spherical harmonic model of the Earth's gravitational potential to degree 360. The model is a static mathematical representation of the Earth's gravity field which incorporates improved surface gravity data, altimeter-derived anomalies, extensive satellite tracking data as well as direct altimeter ranges. The final solution blends a low-degree combination model to degree 70, a block-diagonal solution from degree 71 to 359, and a quadrature solution at degree 360.

INPUTS

- Satellite tracking data (see Table 6.2.1-2 pp 6-17 of the EGM96 report).
  The most important data are SLR (Satellite Laser Ranging), DORIS (Doppler Orbitography and Radio Positioning Integrated by Satellite), GPS (Global Positioning System) and TDRSS tracking of LEO satellites
  (Tracking Data Relay Satellite System).
- Direct Ocean radar altimeter data from TOPEX/Poseidon, ERS-1, and Geosat.
- Surface gravity data in the form of 30'x30' and 1degx1deg anomalies supplied mostly by NIMA (see
  Table 3.5-1, pp3=27 for full list). The mean gravity anomalies over Greenland came largely from airborne gravity surveys.
- Altimeter-derived gravity anomalies:
  GEOSAT (for +/- 72 deg latitude);
  ERS-1 for Weddel Sea, Arctic and Norwegian & Barent's Seas. (see Fig 4.3-1, pp 4-25)



Earth Gravitational Model 1996

OUTPUTS

- Spherical harmonic coefficients to degree and order 360
- Geoid and gravity anomaly grids.
- Station coordinate solutions for tracking stations.
- Solutions for dynamic ocean topography to 20x20 in spherical harmonics for 1993/1994 for Topex/ERS-1
  and 1986 for Geosat.

- Error estimates: Complete calibrated error covariance for spherical harmonic coefficients to 70x70; Coefficient standard deviations for the remaining coefficients to degree 360.

Model Platforms

Access to model product:
Validation: NASA/TP-1998-206861. The Development of the Joint NASA GSFC and the National Imagery and Mapping Agency (NIMA) Geopotential Model EGM96. F.G.Lemoine, S.C. Kenyon, J.K. Factor, R.G. Trimmer, N.K. Pavlis, D.S. Chinn, C.M. Cox, S.M. Klosko, S.B. Luthcke, M.H. Torrence, Y.M. Wang, R.G. Williamson, E.C. Pavlis, R.H. Rapp, and T.R. Olson, NASA Goddard Space Flight Center, July 1998, 575 pages.
Config Control:

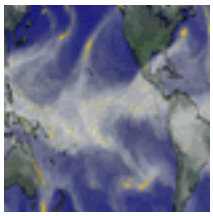
POC: Dr. Frank Lemoine
Affiliation: Code 698, Planetary Geodynamics Laboratory, NASA GSFC
Email Address: frank.lemoine@gsfc.nasa.gov
Phone #: 301-614-6109
Funding: Not currently funded
Contract #: N/A
Contract Name: N/A
Past Funding: Not available
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input:
Website: http://cddis.gsfc.nasa.gov/926/egm96/egm96.html
Model Partners:
- (NGA), formerly the National Imagery and Mapping Agency (NIMA)
- Ohio State University (OSU)

GEOS-4 AGCM

Purpose: Atmospheric component of GEOS-4 assimilation and forecast system.GEOS-4 AGCM is the atmospheric model used at GSFC for data assimilation and for numerical weather prediction. The model can also be used for climate applications and its climate behavior has been well documented in decadal simulations.

INPUTS

- GISS Model III / Atmospheric pressure
- GISS Model III / Humidity
- GISS Model III / Wind velocity



Atmospheric Forecast and Assimilation

OUTPUTS

- Surface geopotential
- Atmospheric temperature
- Atmospheric pressure
- Precipitation rate
- Total precipital water
- Soil moisture
- Wind surface stress
- Surface temperature
- Geopotential height
- Humidity
- Radiation flux
- Surface roughness
- Boundary layer height
- Surface temperature change rate
- Snow depth
- Cloud cover
- Cloud optical depth
- Wind velocity change rate
- Humidity change rate
- Eddy diffusivity
- Cloud mass flux
- Atmospheric temperature change rate
- Surface type
- Wind velocity
- Surface heat and moisture fluxes

Model Platforms
- Surface geopotential
- Atmospheric temperature
- Atmospheric pressure
- Precipitation rate
- Total precipital water
- Soil moisture
- Wind surface stress
- Surface temperature
- Geopotential height
- Humidity
- Radiation flux
- Surface roughness
- Boundary layer height
- Surface temperature change rate
- Snow depth
- Cloud cover
- Cloud optical depth
- Wind velocity change rate
- Humidity change rate
- Eddy diffusivity
- Cloud mass flux
- Atmospheric temperature change rate
- Surface type
- Wind velocity
- Surface heat and moisture fluxes

Access to model product: Results at web site (http://gmao.gsfc.nasa.gov) or contact POA.
Validation: http://gmao.gsfc.nasa.gov
Config Control: GEOS-4.0.3
POC: Max J Suarez
Affiliation: GMAO
Email Address: max.j.suarez@nasa.gov
Phone #: (301) 614-5355
Funding: NASA Hq ESE
Contract #: RTOP-621-85-01
Contract Name:
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: Yes
Website: http://gmao.gsfc.nasa.gov
Model Partners

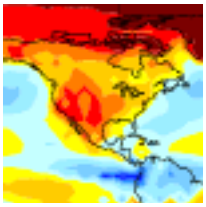
Notes: Note 1: Model resolution: 1 deg x 1.25 deg x 55 vertical layers with 32 SGI processors

GISS ModelE

Purpose: GISS ModelE is multi-purpose flexible tool to examine climate change and interactions over a wide range of space and time-scales. Multiple resolutions, different stratospheric and ocean treatments, and varied tracer submodules (including atmospheric chemistry, aerosols (including sulfates, nitrates, carbonaceous, dust and sea salt) can be optionally included as required. This model is being used for the GISS contribution to the upcoming IPCC 4th Assessment Report.

INPUTS

- 3D aerosol distribution
- Landcover Type
- Sea surface temperatures/sea ice concentration
- TOA solar forcing
- topographic data (DEMs)
- vegetation and soil description
- SAGE II / Ozone



Earth System General Circulation Model

OUTPUTS

- Optical thickness of individual and total aerosols
- Column burden of individual aerosol species
- Total aerosol concentration
- Individual aerosol concentration
- 3-D distribution of each aerosol type
- Absorption
- Heating / Cooling Rates
- 3-D ocean temperature field
- 3-D ocean salinity field
- 3-D ocean velocity components
- Sea surface height
- Surface geopotential
- Atmospheric temperature
- Sensible heat flux
- Atmospheric pressure
- Precipitation rate
- Total precipitable water
- Soil moisture
- Wind surface stress
- Surface temperature
- Geopotential height
- Humidity
- Surface evaporation
- Surface albedo
- Friction velocity
- Boundary layer height
- Surface temperature change rate
- Snow depth
- Cloud cover
- Cloud optical depth
- Wind velocity change rate
- Humidity change rate
- Ozone concentration
- Atmospheric temperature change rate
- Wind velocity
- Water balance
- surface radiation budget
- Energy balance
- Runoff
- Soil Temperature
- Snow water equivalent
- Latent heat flux
- Ground heat flux
- Evapotranspiration
- Evaporation
- Transpiration
- Sea surface temperature
- Surface heat and moisture fluxes
- Ocean bottom pressure
- 3-D mixing tensor
- Aerosol radiative forcing
- Water vapor mixing ratio
- Snowfall amount
- Sea surface salinity
- Sea ice area fraction
- Stress at sea ice base
- Momentum flux
- Sea ice melting flux
- Sea ice thickness
- Sea ice temperature
- Sea ice velocity
- Ocean surface current

Note: This is the official GISS successor to the GISS Model II, Model II and Model III series of models incoporating much new physics and tracer sub-modules, more user friendly interfaces and more modern coding practice (including support for OpenMP, MPI and ES. Also note that the output list is not exhaustive.

Model Platforms
- SGI
- IBM
- Linux
- Compaq

Program Size: 4x5x20L: 2.6 MB
Run Time: example: ~4 model years/day with parameters listed in note 1
Resolution
Temporal: 30 minute physics time step (but can vary)
Vertical: 12 to 53 atmospheric levels, variable ocean resolution
Horizontal: 8x10, 4x5, 2x2.5
Range
Temporal: Years to Centuries
Vertical:surface to 0.1mb and optionally up to 0.002mb
Horizontal: Global

Access to model product:
http://www.giss.nasa.gov/tools/modelE

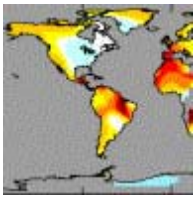
Validation: Schmidt et al (in preparation - see website)
Config Control: ModelE1
POC: Gavin Schmidt
Affiliation: NASA Goddard Institute for Space Studies
Email Address: gschmidt@giss.nasa.gov
Phone #: 212 678 5627
Funding: NASA Civil Servant
Contract #: RTOP 622-24-01-30
Contract Name:
Past Funding: Multiple awards to present
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: No
Website: http://www.giss.nasa.gov/tools/modelE
Model Partners

GISS II

Purpose: To examine the effects of multiple radiative forcings on long term climate

INPUTS

- 3D aerosol distribution
- Sea surface temperatures/sea ice concentration
- TOA solar forcing
- topographic data (DEMs)
- vegetation and soil description
- SAGE II / Ozone



Global Forcings

OUTPUTS

- Absorption
- Heating / Cooling Rates
- Surface geopotential
- Atmospheric temperature
- Atmospheric pressure
- Precipitation rate
- Total precipital water
- Wind surface stress
- Geopotential height
- Humidity
- Boundary layer height
- Cloud cover
- Cloud optical depth
- Wind velocity change rate
- Cloud mass flux
- Wind velocity
- Surface heat and moisture fluxes
- Water vapor mixing ratio
- Momentum flux

Model Platforms

- IBM
- SGI

Program Size: 4x5x12L, 7.6 MB
Run Time: single processor, 1 yr/day
Resolution
Temporal: one hour
Vertical: 12 layers
Horizontal: 4x5
Range
Temporal: years to a century
Vertical: surface to 10mb
Horizontal: Global

Access to model product: http://data.giss.nasa.gov
Validation: Hansen et al (1983), Hansen et al (2002)
Config Control: SI2000
POC: Mark A. Chandler
Affiliation: Columbia University-CCSR/GISS
Email Address: mchandler@giss.nasa.gov
Phone #: 212-678-5644
Funding: NASA
Contract #: RTOP 622-24-01-30
Contract Name:
Past Funding: To 2003
Currently Use NASA Data Products as Input: No
Being Investigated for Use of NASA Data Products as Input: No
Website: http://www.giss.nasa.gov/data/
Model Partners: Columbia University

Notes: Data from atmospheric runs including multiple radiative forcings are still available from the SI2000 version of the model (see website), but the model code itself is no longer officially supported. Please see GISS ModelE for more up-to-date model results and capabilities.

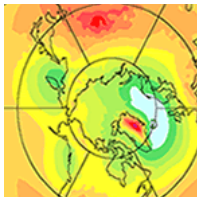
The primary use for GISS Model II these days is as the core to a suite of educational climate modeling software called EdGCM, which has a web presence at Columbia University (http://edgcm.columbia.edu). Model II is still used, also, for most of the ancient Earth paleoclimate modeling, astrobiology, and Mars studies that are conducted with a NASA/GISS GCM.

GISS III

Purpose: This model is intended for research requiring finer vertical and horizontal resolution than is generally employed in the GISS climate runs. It is an extension of Model II' (which was an extension of Model II), incorporates the GISS Middle Atmosphere Model and uses some of the new physics routines in Model E (the latest model for primarily tropospheric climate change experiments). It routinely runs with a top at the mesopause, so is appropriate for stratospheric experiments as well as tropospheric ones.

INPUTS

- 3D aerosol distribution
- Radiation, temperature, precip data for validation
- SEA SURFACE TEMPERATURES



General Atmospheric and Ocean Circulation Model

OUTPUTS

- Optical thickness of individual and total aerosols
- Absorption
- Single scattering albedo
- Heating / Cooling Rates
- Surface geopotential
- Atmospheric temperature
- Atmospheric pressure
- Precipitation rate
- Total precipital water
- Wind surface stress
- Geopotential height
- Humidity
- Friction velocity
- Boundary layer height
- Cloud cover
- Cloud optical depth
- Wind velocity change rate
- Humidity change rate
- Eddy diffusivity
- Cloud mass flux
- Ozone concentration
- Atmospheric temperature change rate
- Wind velocity

Model Platforms

Model Platforms
- SGI-TYPE SHARED MEMORY SYSTEM
Program Size: 4x5x53layer: 328 MB; 2X2.5X53layer: 678 MB
Run Time: (4x5x53): 2.25min/day; (2x2.5x53): 20.2 min/day; on Origin3000@400MHz, 24proc
Resolution
Temporal: 1 hour
Vertical: 500m-1km (53, 102 level versions)
Horizontal: 4°x5° or 2°x2.5°
Range
Temporal: 50 year simulations
Vertical: Surface to 85km
Horizontal: Global

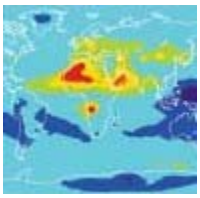
Access to model product: Contact model owner
Validation: NOT YET
Config Control: NA
POC: David Rind; Jeff Jonas
Affiliation: NASA GISS/Columbia University
Email Address: drind@giss.nasa.gov; jonas@giss.nasa.gov
Phone #: 212-678-5593; 212-678-5532
Funding: NASA; Columbia University
Contract #: 622-59-04-30
Contract Name:
Past Funding: MULTIPLE YEAR FUNDING HISTORY
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: Yes
Website: planned for the future
Model Partners

Notes:Higher resolution models for understanding atmospheric dynamical changes and regional responses related to climate change; also tropospheric and stratospheric tracers and atmospheric chemistry changes associated with altered climate

GSFC Aerosol Assimilation System

Purpose:

INPUTS



OUTPUTS

----WAITING ON INPUT----

Model Platforms

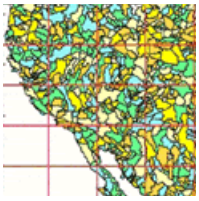
Access to model product:

GSFC Catchment LSM

Purpose: The Catchment LSM, designed to work with atmospheric GCMs, computes the energy and water balances at the earth's surface. It differs from more traditional land models in its explicit treatment of subgrid soil moisture variability and the impact of this variability on evaporation and runoff.

INPUTS

- Meteorological forcing (from atmospheric model, or reanalysis, or obs network, etc.)
- topographic data (DEMs)
- vegetation and soil description



Impacts of soil moisture variability on surface fluxes

OUTPUTS

- Sensible heat flux
- Soil moisture
- Surface temperature
- Surface evaporation
- Radiation flux
- Snow depth
- Water balance
- surface radiation budget

Model Platforms

- Anything, if run offline (unattached to GCM)
- Super Computer (with AGCM)

Program Size: ~4000 lines of code
Run Time: <6 sec/year/element, depending on platform used
Resolution
Temporal: 30 minutes
Vertical: three soil moisture prognostic variables
Horizontal: catchments of about 50 km on a side
Range
Temporal: Any time, given availability of boundary condition data
Vertical: vegetation canopy to bedrock
Horizontal: anywhere

Access to model product: Most products are distributed in the form of scientific papers or research reports that provide a description of results. Some side application products are distributed through the GSWP (Global Soil Wetness Project) mostly as meteorological resources.
Validation: Boone et al., J. Climate, 17, pp. 187-208, 2004
Config Control: n/a
POC: Randal Koster
Affiliation: GMAO, NASA/GSFC
Email Address: randal.d.koster@nasa.gov
Phone #: 301-614-5781
Funding: NASA
Contract #: RTOP 51-622-33-88
Contract Name:
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: No
Website:
http://nsipp.gsfc.nasa.gov/research/land/land_descr.html
Model Partners
- Lamont-Doherty Earth Observatory

Notes:1. Reference 1: Journal of Geophysical Research, Vol. 105, No. D20, pgs. 24,809-24,822, Oct. 27, 2000 2. Reference 2: Journal of Geophysical Research, Vol. 105, No. D20, pgs. 24,823-24,838, Oct. 27, 2000. 3. NASA data products are not used as model inputs on a regular basis, however, they are occasionally used to outline a research project or define boundary conditions.

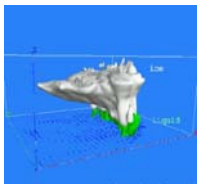
Information Last Updated: 8/30/2004

GSFC CEM

Purpose: The objective is to simulate clouds and cloud systems from various geographic locations that are generally convective in nature in order to: 1) produce a consistent cloud data base for algorithm developers and for large-scale modelers to improve their convective parameterizations, 2) study cloud processes (e.g. microphysical processes) and their interaction with radiation, aerosols, and land and ocean surface processes, 3) perform long term equilibrium state simulations in the tropics, 4) study cloud chemistry and transport, and 5) to serve as a super parameterization within a general circulation model (also known as a multi-scale modeling framework or MMF).

INPUTS

- Meteorological forcing (from atmospheric model, or reanalysis, or obs network, etc.)
- Radiosonde / Moisture
- Radiosonde / Pressure
- Radiosonde / Temperature
- Radiosonde / Wind
- GMAO Atmospheric Analysis / Atmospheric pressure
- GMAO Atmospheric Analysis / Atmospheric temperature
- GMAO Atmospheric Analysis / Humidity
- GMAO Atmospheric Analysis / Wind velocity
- GEOS DAS - Goddard Earth Observing System - Data Assimilation System
- data collected from NASA field campaigns (e.g., CRYSTAL,TRMM LBA, KWAJEX, SCSMEX)



Non-hydrostatic cloud-resolving model

OUTPUTS

- Microphysical Heating/Cooling Rates
- Radiative Heating/Cooling Rates
- Atmospheric temperature
- Atmospheric pressure
- Precipitation rate
- Total precipital water
- Humidity
- Cloud cover
- Wind velocity change rate
- Humidity change rate
- Cloud mass flux
- Atmospheric temperature change rate
- Wind velocity
- Surface heat and moisture fluxes
- Water vapor mixing ratio
- Momentum flux

Model Platforms
- Alpha SC on a Compaq SC45
- SGI Altix 3000
Program Size: 44,000 lines of code
Run Time: 860 s for a 4 h simulation using 64 CPUs, a 256x256x34 domain, and a 10 s time step
Resolution
Temporal: 10 seconds or less
Vertical: stretched: 10 m to 1000 m
Horizontal: 250 m up to 2000 m
Range
Temporal: 12 hours up to multi-week
Vertical: 0 up to 30 km (AGL)
Horizontal: up to several 1000 km

Access to model product: Contact Dr. Tao or Steve Lang via e-mail
Validation: Tao, W.-K., and J. Simpson, 1993: The Goddard Cumulus Enemble Model. Part I: Model description. Terr., Atmos. and Oceanic Sci., 4, 35-72.
Config Control: GCE_3D_MPI_V1.0
POC: Steve Lang
Affiliation: SSAI/NASA GSFC
Email Address: lang@agnes.gsfc.nasa.gov
Phone #: 301-614-6331
Funding: NASA
Contract #: 621-15-42, 622-28-04-20, 622-28-03-20, 291-01-97
Contract Name: TRMM/GPM Precipitation Mission,Cumulus Modeling,Parameterized Convective Processes
Past Funding: 621-30-07 (1993)

Currently Use NASA Data Products as Input: No
Being Investigated for Use of NASA Data Products as Input: Yes
Website: None.
Model Partners
- University of Maryland
- University of Virginia
- Columbia University
- University of New York--Albany
- Florida State University
- University of Washington
- Hebrew University of Jerusalem in Israel
- National Central University
- National Taiwan University
- Austin College
- Seoul National University
- Texas A&M University

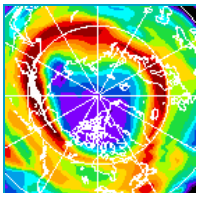
Notes:Several national and international universities and research institutions (listed under model partners) are using the GCE model and its results in their research. These professors and researchers are important partners because they can inform us about the model performance. References in addition to the one listed under validation information: Tao, W.-K., J. Simpson, and S.-T. Soong, 1987: Statistical properties of a cloud ensemble: A numerical study. J. Atmos. Sci., 44, 3175-3187. Simpson, J., and W.-K. Tao, 1993: The Goddard Cumulus Ensemble Model. Part II. Applications for studying cloud precipitating processes and for NASA TRMM. Terr., Atmos. and Oceanic Sci., 4, 73-116.Tao, W.-K., J. Simpson, D. Baker, S. Braun, M.-D. Chou, B. Ferrier, D. Johnson, A. Khain, S. Lang, B. Lynn, C.-L. Shie, D. Starr, C.-H. Sui, Y. Wang and P. Wetzel, 2003: Microphysics, radiation and surface processes in a the Goddard Cumulus Ensemble (GCE) model, Meteor. and Atmos. Phys., 82, 97-137.Tao, W.-K., 2003: Goddard Cumulus Ensemble (GCE) model: Application for understanding precipitation processes, AMS Monographs - Cloud Systems, Hurricanes and TRMM. 1003-138. Juang, H.M., W.-K. Tao, X. Zeng, C.-L. Shie and J. Simpson, 2004: A message passing interface implementation to a cloud-resolving model for massively parallel computing, TAO (accepted). There have been over 100 refereed publications based on the GCE model.

GSFC CTM

Purpose: The Goddard Chemistry and Transport Model was developed to investigate processes affecting the evolution of stratospheric ozone on seasonal to multi-decadal time scales. Winds and temperatures are input to the model and may be taken from a data assimilation system (DAS) or from a general circulation model (GCM). Simulations using DAS winds are used to interpret observations and to investigate processes that affect stratospheric ozone, emphasizing processes that should be represented in fully-coupled chemistry/climate simulations. These processes are investigated in simulations using GCM winds to demonstrate the credibility of the GCM and its applicability to assessment.

INPUTS

- kinetic information for photochemical reaction rates
- solar flux
- cross sections for dissociation rates
- boundary conditions for source gases
- meteorological fields
- winds
- temperatures



Goddard Atmospheric Chemistry and Transport Model

OUTPUTS

3 dimensional fields for constituents of stratospheric importance

Model Platforms:
HP AlphaServer SC45
SGI Altix 3700 BX2
Linux (gentoo)
Program Size: 3.5 MB
Run Time: Varies with platform and temporal resolution/range; sample: 10 days simulated in 2 hrs on the Altix (4 cpus, timestep=15min)
Resolution -Temporal: Typically 15 minutes
Resolution -Vertical: 28 levels: ~ 1 km near tropopause; ~ 3 km middle stratosphere; ~ 6 km at upper boundary
Resolution -Horizontal nominal: 2 lat x 2.5 lon; high: resolution 0.5 lat x 0.625 lon
Range -Temporal: seasonal to multi-decadal
Range - Vertical: surface to 0.6 hPa (~ 60 km)
Range -Horizontal: global

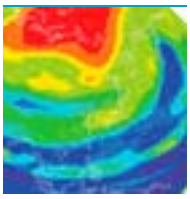
Access to model product: contact POC
Validation: Trends in Stratospheric Ozone: Lessons Learned from a 3D Chemical Transport Model, Stolarski et al., Journal of the Atmospheric Sciences, 2006 and references therein. The Sensitivity of Arctic Ozone Loss to Polar Stratospheric Cloud Volume and Chlorine and Bromine Loading in a Chemistry and Transport Model, Douglass et al., Geophysical Research Letters, 2006
Config control: Not applicable
Funding: NASA Atmospheric Chemistry Modeling and Analysis (ACMAP)
Past Funding: NASA ACMAP
Website: http://code916.gsfc.nasa.gov/Public/Modelling/3D/ctm.html
POC: Anne R Douglass
Affiliation: NASA GSFC Atmospheric chemistry and dynamics branch - Code 613.3
Email Address: Anne.R.Douglass@nasa.gov
Phone: 301 614 6028

GSFC GMI CTM

Purpose: The purpose of GMI is to develop and maintain a state-of-the-art modular 3-D chemistry and transport model (CTM) that can be used for assessment of the impact of various natural and anthropogenic perturbations on atmospheric composition and chemistry. The GMI model also serves as a testbed for model improvements.

INPUTS

GEOS-4-AGCM meteorological fields
GEOS-4-DAS meteorological fields
GEOS-4-forecast meteorological fields
GISS-II' meteorological fields
GEOS-1-DAS meteorological fields
Surface emissions inventories
Many met fields possible



The Global Modeling Initiative Chemistry and Transport Model

OUTPUTS

Any chemical constituent in the mechanism selected (tropospheric, stratospheric, or both)
Any aerosol species if aerosol mechanism selected

Model Platforms
NCCS HP AlphaServer SC45
NCCS SGI Altix 3700 BX2
NCCS Linux Network Cluster
Program Size: 10-12 GB
Run time: depends on chemical mechanism and resolution chosen
Resolution: hourly to monthly (user determined)
Resolution Vertical: variable
Resolution Horizontal: 2 degree latitude x 2.5 degree longitude, or 4 degree latitude x 5 degree longitude
Temporal Range: depends on the experiment
Range Vertical: depends on the meteorological fields chosen
Range Horizontal: global

Access to model product: contact model POC
Validations: http://gmi.gsfc.nasa.gov/gmi_pubs.html
Config. Control:
POC: Dr. Susan Strahan; Dr. Jose Rodriguez
Affiliation: University of Maryland Baltimore County; NASA Goddard Space Flight Center
Currently use NASA product as input: yes
E-mail: sstrahan@pop600.gsfc.nasa.gov; jrodriguez@pop600.gsfc.nasa.gov
Phone #: 301-614-5995; 301-614-5736
Being Investigated for Use of NASA Products as Input: yes
Website: http://gmi.gsfc.nasa.gov
Model Partners:

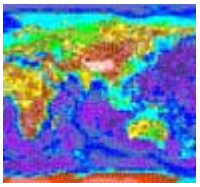
Notes:

GSFC GOCART

Purpose: Use GOCART model to simulate atmospheric aerosols and trace gases to study climate forcing and global air quality.

INPUTS

- Anthropogenic and volcanic emission inventories
- MODIS fire products for estimating biomass burning emissions
- GEOS DAS / Atmospheric pressure
- GEOS DAS / atmospheric temperature
- GEOS DAS / Boundary layer height
- GEOS DAS / Cloud cover
- GEOS DAS / Cloud optical depth
- GEOS DAS / Eddy diffusivity
- GEOS DAS / Humidity
- GEOS DAS / Precipitation rate
- GEOS DAS / Radiation flux
- GEOS DAS / Soil moisture
- GEOS DAS / Surface roughness
- GEOS DAS / Surface temperature
- GEOS DAS / Surface type
- GEOS DAS / Wind velocity



Aerosol Transport

OUTPUTS

- Dust emission
- Sea-salt emission
- 3-D concentrations and 2-D column amount of individual and total aerosols
- 3-D concentrations and 2-D column amount of gas species of CO, SO2, and DMS
- 3-D distributions of aerosol particle size
- 3-D and 2-D column distributions of aerosol extinction (optical depth), backscattering, and absorption at multiple wavelengths
- 3-D and 2-D distributions of fine and coarse mode aerosol extinction (optical depth)
- Anthropogenic fraction of aerosol concentrations and optical depth
- Aerosol radiative forcing at the top of the atmosphere, at the surface, and within the atmosphere
- Change of atmospheric heating rate due to aerosols
- Surface PM2.5 and PM10 concentrations
- Deposition of aerosols at earth's surface

Model Platforms

- GSFC NCCS SGI/Altix system
- GSFC NCCS Linux Networx
- GSFC SGI Origin 3000

Program Size: Approximately 300 M Words
Run Time: Example: 12 - 14 min CPU / day with the parameters listed in notes.
Resolution
Temporal: 15 minutes (interpolated) to 6 hour time steps
Vertical: 20 - 55 layers
Horizontal: 1 degree latitude X 1.25 degree longitude (planned to beincreased)
Range
Temporal: 1980 - present
Vertical: Sea Level to 0.001 mbar
Horizontal: global

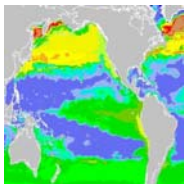
Access to model product: http://code916.gsfc.nasa.gov/People/Chin/aot.html (or contact model POC)
Validation: N/A
Config Control: Version 4 as of November 2006
POC: Mian Chin
Affiliation: NASA GSFC Code 613.3
Email Address: Mian.Chin-1@nasa.gov
Phone #: 301-614-6007
Funding: NASA
Contract #: N/A
Contract Name:
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: Yes
Website: http://hyperion.gsfc.nasa.gov/People/Chin/aot.html
Model Partners
Notes:1. Model parameters for example run time: Model resolution: 2 deg latitude x 2.5 deg longitude, 30 vertical layers. Time steps: 15 min for advection and cloud mixing, 1 hour for emission,chemistry, dry deposition, settling, wet deposition. Number of species (or groups): Dust (5), sea-salt (4), carbonaceous (4), sulfur (4), total 17

GSFC Ocean Biology

Purpose: To produce a realistic simulation of ocean biological and biogeochemical processes that can be related to ocean color observations from space and provide improved state and flux estimates.

INPUTS

- MODIS / MOD04: Aerosol Product
- MODIS / MOD21: Chlorophyll a Pigment Concentration
- SeaWiFS / SeaWiFS Level 3 Monthly Data
- TOMS / TOMS: Ozone
- GMAO Ocean Analysis / 3-D ocean tempera ture field
- GMAO Atmospheric Analysis / Atmospheric pressure
- GSFC GOCART / Dust emission
- GMAO Atmospheric Analysis / Humidity
- GMAO Atmospheric Analysis / Wind velocity



Global ocean biology / biogeochemistry simulation

OUTPUTS

- chlorophyll
- primary production
- phytoplankton functional groups
- carbon flux

Model Platforms
- halem
Program Size: 22000
Run Time: 1 hour per simulated month
Resolution
Temporal: 1/2 hr
Vertical: 5 to 200 m
Horizontal: 1 1/4 lon by 2/3 lat
Range
Temporal: years
Vertical: 5000 m
Horizontal: global

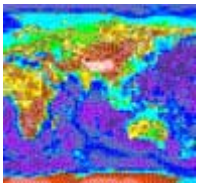
Access to model product: contact Model POC
Validation: Gregg, W.W., P. Ginoux, P.S. Schopf, and N.W. Casey, 2003. *See Note 1.
Config Control: NA
POC: Watson Gregg
Affiliation: NASA/Global Modeling and Assimilation Office
Email Address: Watson.Gregg@nasa.gov
Phone #:(301) 614-5711
Funding: NASA
Contract #: 51-621-30-39
Contract Name: Development of an Ocean Biogeochemical EOS Assimilation Model (OBEAM)
Past Funding: 1991 to present, NASA Biogeochemistry Program
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: No
Website:
Model Partners

GSFC Ozone Assimilation System

Purpose: This global system assimilates ozone data from multiple satellite-borne sensors into a global three-dimensional stratosphere/troposphere model. The model includes detailed transport and parameterized chemistry processes. The assimilated ozone fields were used in studies of upper atmospheric waves, monitoring and evaluation of retrieved ozone data from satellite instruments,representation of ozone in the lower stratosphere, and evolution of polar ozone. Potential applications include: studies of radiative feedback from ozone in atmospheric general circulation models (GCMs), use as first guess field in retrievals from various satellite instruments, and use in assimilation of radiances from infrared instruments (e.g. TOVS or AIRS). Assimilation of EOS Aura data provides tropospheric ozone columns and profiles that could potentially be used for air quality applications.

INPUTS

- MLS / ML2O3: Ozone (O3) Mixing Ratio
- OMI / OMI OMTO3: Total Ozone
- SAGE II / Ozone
- SBUV-2 / ozone
- MIPAS / ozone
- POAM III / ozone
- TOMS / TOMS: Ozone
- HALOE / UARS HALOE Level 2 Data
- GMAO Atmospheric Analysis / Atmospheric pressure
- GMAO Atmospheric Analysis / Atmospheric temperature
- GMAO Atmospheric Analysis / Humidity
- GSFC 2D Model / ozone production and loss rates
- GEOS-CHEM / ozone production, loss and dry depositon
- GMAO Atmospheric Analysis / Wind velocity



Assimilation System for Atmospheric Ozone Data

OUTPUTS

- ozone mixing ratio
- Total Ozone Column

Model Platforms

- GSFC SGI Origin (Daley)
Program Size: 15000
Run Time: 20 - 40 min
Resolution
Temporal: 15 min to 6 hours
Vertical: 36 levels
Horizontal: 1x1.5 deg to 2x2.5 deg
Range
Temporal: 1991 to present
Vertical: surface to 60 km
Horizontal: global

Access to model product:
http://gmao.gsfc.nasa.gov/research/ozone/ozone_assim.php
Validation: Stajner, I. et al. (2001) Q. J. R. Meteorol. Soc., vol. 127; Stajner I. et al. (2004) J. Geophys. Res., Vol. 109
Config Control: CVS at sourcemotel.gsfc.nasa.gov; current tag: hh-cloy
POC: Ivanka Stajner
Affiliation: SAIC and NASA Goddard
Email Address: istajner@gmao.gsfc.nasa.gov
Phone #: (301) 614-6177
Funding: NASA
Contract #: RTOP 622-55-51-20
Contract Name: US OMI science team
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: No
Website:
Model Partners

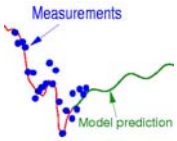
Notes:

GSFC 2D Model

Purpose: The model is used to help in understanding and predicting the influence of natural and human-induced influences on stratospheric ozone variation.

INPUTS

- Solar flux
- Source gases
- NCEP Analysis / Atmospheric Temperature
- NCEP Analysis / Geopotential Height



Two-dimensional (latitude vs. altitude) model of the Earth's atmosphere

OUTPUTS

- stratospheric ozone and related trace gases

Model Platforms

- Silicon Graphics Origin 200
Program Size: ~10,000
Run Time: ~80 minutes of computer time for one year of model time
Resolution
Temporal: 1 day
Vertical: ~2 km
Horizontal: 10 degrees
Range
Temporal: 1960-2050
Vertical: Ground to 90 km
Horizontal: South pole to North pole

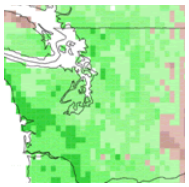
Access to model product: Contact model POC
Validation: Fleming, E. L., C. H. Jackman, J. E. Rosenfield, D. B. Considine, J. Geophys. Res., 107, D23, 4665, doi:10.1029/2001JD001146, 2002.
Config Control: Not Applicable
POC: Charles Jackman
Affiliation: NASA Goddard Space Flight Center
Email Address: Charles.H.Jackman@nasa.gov
Phone #: 301-614-6053
Funding: NASA
Contract #: RTOP 622-58-03
Contract Name: ACMAP - Atmospheric Chemistry Modeling and Analysis Project
Past Funding:
Currently Use NASA Data Products as Input: No
Being Investigated for Use of NASA Data Products as Input: No
Website:
http://code916.gsfc.nasa.gov/Public/Modelling/2D/2d.html
Model Partners

Mosaic LSM

Purpose: This is a well-tested, large-scale soil-vegetation-atmosphere-transfer(SVAT) model for use with atmospheric general circulation models. Vegetation heterogeneity is treated through a tiling approach.

INPUTS

- Meteorological forcing (from atmospheric model, or reanalysis, or obs network, etc.)
- vegetation and soil description



Energy, Water Flux

OUTPUTS

- Sensible heat flux
- Soil moisture
- Surface temperature
- Surface evaporation
- Surface albedo
- Snow depth
- Water balance
- surface radiation budget

Model Platforms
- Anything, if run offline (unattached to GCM)
Program Size: 2000 lines
Run Time: TBD
Resolution
Temporal: 30 minutes
Vertical: 3 soil layers, one snow layer
Horizontal: Meant to represent GCM grid element (100s of km)
Range
Temporal: Any time, given availability of boundary condition data
Vertical: vegetation canopy to ~3 meters into soil
Horizontal: anywhere

Access to model product: Most products are distributed in the form of scientific papers or research reports that provide a description of results. Some side application products are distributed through the GSWP (Global Soil Wetness Project) mostly as meteorological resources.
Validation: pilps 2c: Wood et al., J. Glob. Planet. Change, 19, pp. 115-135, 1998.
Config Control: n/a
POC: Randal Koster
Affiliation: GMAO, NASA/GSFC
Email Address: randal.koster@gsfc.nasa.gov
Phone #: 301-614-5781
Funding: NASA
Contract #: RTOP 51-622-33-88
Contract Name:
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: No
Website:
http://nsipp.gsfc.nasa.gov/research/land/land_descr.html
Model Partners

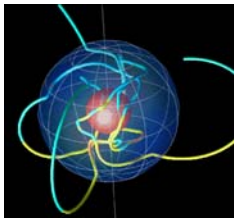
Notes:Reference: NASA Technical Memorandum 104606, Vol. 9.

Current use of NASA data is not checked because NASA data products are not used on a regular basis; they are occasionally used to outline a research project or define boundary conditions.

MoSST

Purpose:

INPUTS



OUTPUTS

Model Platforms:

Access to model product:

POC: Dr. Weijia Kuang
Affiliation: Planetary Geodynamics Laboratory, Code 698, Goddard Space Flight Center

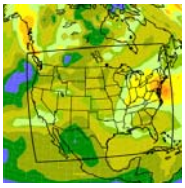
Email Address: Weijia.Kuang-1@nasa.gov
Phone: (301) 614-6108
Website: http://mosst.gsfc.nasa.gov/

RAQMS

Purpose: The LaRC/UW Regional Air Quality Modeling System (RAQMS) is a multi-scale meteorological and chemical modeling system for assimilating satellite observations of atmospheric composition and predicting atmospheric trace gas distributions.

INPUTS

- CO emission inventory
- NOx emission inventory
- POAM II / Ozone
- SAGE II / SAGE II: V6.20 Aerosol, O3, NO2, H2O Binary
- SAGE III / SAGE III G3ASSP: L2 Solar Event Species Profile
- TOMS / TOMS: Ozone
- GEOS-4 AGCM / Atmospheric pressure
- GEOS-4 AGCM / Atmospheric temperature
- GEOS-4 AGCM / Humidity
- GEOS-4 AGCM / Wind velocity



Air Quality Model

OUTPUTS

- Atmospheric pressure
- Ozone concentration

Model Platforms
Unix, Linux
Program Size: 1 Gb executable
Run Time: 8 model days/24hr wall clock on dual 3Ghz Linux processors
Resolution
Temporal: 6hr
Vertical: 36 levels (global) / 50 400-m levels (regional)
Horizontal: variable: baseline 2 deg (global) / 80 km (regional)
Range
Temporal: Seasonal
Vertical: 60 km (global) / 20 km (regional)
Horizontal: Global/Contential US

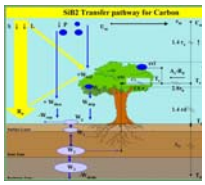
Access to model product: Products are not distributed through a DAAC. Most are available through Field Mission Data Sets, or through the project itself.
Validation: Pierce, R. B. et al., Regional Air Quality Modeling
System (RAQMS) predictions of the tropospheric ozone budget over east Asia, J. Geophys. Res. 108,
Config Control:
POC: Dr. Robert B. Pierce
Affiliation: NASA Langley Research Center
Email Address: Robert.B.Pierce@nasa.gov
Phone #: (757) 864-5817
Funding: NASA
Contract #: 622-59-26-70
Contract Name:
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: No
Website: http://asd-www.larc.nasa.gov/new_AtSC/raqms.html
Model Partners
- University of Wisconsin-Madison

SiB2

Purpose: SiB, the Simple Biosphere Model, calculates the exchange of energy, moisture, momentum and trace gases between the atmosphere and terrestrial biosphere. When Piers Sellers introduced SiB in 1986, he expressed the desire to create a model that would be useful to both atmospheric scientists as well as ecologists. As we continue to develop SiB, we keep this intent in mind. SiB has been used in a variety of meteorological and ecological settings, including use as a lower boundary coupled to an atmospheric model (both global Atmospheric General Circulation Models-AGCMs as well as mesoscale models and tracer transport models). SiB can be used to simulate the surface exchange of many gases, including methane, carbonyl sulfide, and most commonly, CO2. SiB has the ability to simulate the fractionation of carbon and water species as well.

INPUTS

- temperature
- water mixing ratio
- precipitation
- wind speed
- radiation (longwave and shortwave)
- NDVI (to calculate vegetation phenology; a prognostic phenology module is currently in development)
- GiMMSg NDVI, MODIS LAI/fPAR products



The Simple Biosphere Model

OUTPUTS

- latent heat, sensible heat, CO_2 flux
- vegetation temperature
- canopy air space temperature and moisture
- soil temperature
- soil moisture (water and ice components treated explicitly)
- snow depth

Model Platforms:
SiB has been coupled to the Colorado State University General Circulation Model, to mesoscale models such as RAMS, as well as used in stand-alone mode.
Program Size: SiB is composed of approximately 18,000 lines of code in 65 routines
Run Time: SiB can run for one year at a single point (with a 10-minute timestep) in 1 or 2 minutes. Shorter timesteps or more points will take longer
Resolution -Temporal: SiB can run on timesteps from seconds (or fraction of seconds) to approximately 30 minutes
Resolution - Vertical: SiB is a land surface model, and as yet does not have vertical resolution. However, the model architecture makes inclusion of a vertically resolved canopy model possible.
Resolution - Horizontal: SiB can be run at almost any horizontal resolution, from meters to kilometers.
Range - Temporal: 0.2 seconds to 15 minute
Range - Vertical: NA

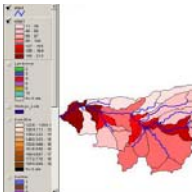
Access to model product: contact POC
Validation: SiB has been used in a variety of scientific settings for 20 years, and is used/mentioned in well over 100 journal articles. Contact POC for model validation documents.
Config control: SiB is written in FORTRAN90, version control maintained by subversion
Currently Use NASA Products as Input: yes

AGWA

Purpose: Planning and assessment in land and water resource management are evolving from simple, local-scale problems toward complex, spatially explicit regional ones. Such problems have to be addressed with distributed models that can compute runoff and erosion at different spatial and temporal scales. The extensive data requirements and the difficult task of building input parameter files, however, have long represented an obstacle to the timely and cost-effective use of such complex models by resource managers. The USDA-ARS Southwest Watershed Research Center, in cooperation with the U.S. EPA Office of Research and Development, has developed a GIS tool to facilitate this process. A geographic information system (GIS) provides the framework within which spatially-distributed data are collected and used to prepare model input files and evaluate model results.

INPUTS

- Digital Elevation Model
- Landcover Type
- Precipitation
- Soil Hydraulic Properties
- Soil Physical properties
- TM / Land cover
- X-SAR / SRTM



GIS-based hydrologic modeling tool

OUTPUTS

- Runoff
- Infiltration
- Peak flow
- Sediment yield
- Sediment discharge
- ET
- Percolation
- Surface runoff
- Transmission loss
- Water yield

Model Platforms
- Windows
- ArcView Spatial Analyst Extension
- ArcView 3.1 or later
Program Size: 212kb; with sample data/tutorials 139MB
Run Time: variable
Resolution
Temporal: variable, seconds to minutes
Vertical: variable, 1cm-1m (soil depth)
Horizontal: variable, 1m-100m
Range
Temporal: variable, minutes to years
Vertical: variable, 1m-10m (soil depth)
Horizontal: variable, 100mx100m - 100kmx100km

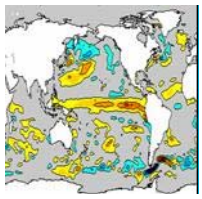
Access to model product: please contact model Point of Contact
Validation:
Config Control: 1.32
POC: Darius Semmons
Affiliation: USDA-ARS
Email Address: agwa@tuscon.ars.ag.gov
Phone #: 520-670-6380 x 163
Funding: USDA, USEPA, USACE
Contract #:
Contract Name:
Past Funding:
Currently Use NASA Data Products as Input: No
Being Investigated for Use of NASA Data Products as Input: Yes
Website: http://www.tucson.ars.ag.gov/agwa/
Model Partners
- USDA
- USEPA

Notes:

CIMMS-CCM

Purpose:

INPUTS



OUTPUTS

----WAITING ON INPUT----

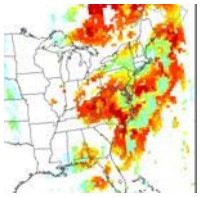
Model Platforms

Access to model product:

CIP

Purpose:

INPUTS



OUTPUTS

----WAITING ON INPUT----

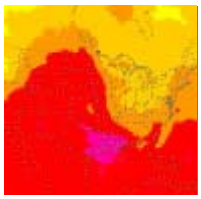
Model Platforms

Access to model product:

FIP

Purpose:

INPUTS



OUTPUTS

----WAITING ON INPUT----

Model Platforms

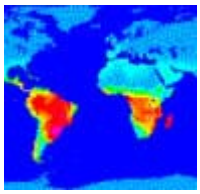
Access to model product:

GEOS-CHEM

Purpose: The GEOS-CHEM model is a global three-dimensional model of atmospheric composition driven by assimilated meteorological observations from the Goddard Earth Observing System (GEOS) of the NASA Global Modeling and Assimilation Office (GMAO). GEOS-CHEM is intended for application to a wide range of atmospheric chemistry problems. GEOS-CHEM is also a tool for supporting other activities such as: assessments (Global Modeling Initiative or GMI), satellite retrievals (NASA, CSA, ESA), regional air quality models (Community Multiscale Air Quality Modeling System or CMAQ), data assimilation (GMAO), and climate models (NASA Goddard Institute of Space Studies or GISS).

INPUTS

- GEOS-4 AGCM / Atmospheric pressure
- GEOS-4 AGCM / Atmospheric temperature
- GEOS-4 AGCM / Atmospheric temperature change rate
- GEOS-4 AGCM / Boundary layer height
- GEOS-4 AGCM / Cloud cover
- GEOS-4 AGCM / Cloud mass flux
- GEOS-4 AGCM / Cloud optical depth
- GEOS-4 AGCM / Geopotential height
- GEOS-4 AGCM / Humidity
- GEOS-4 AGCM / Humidity change rate
- GEOS-4 AGCM / Precipitation rate
- GEOS-4 AGCM / Radiation flux
- GEOS-4 AGCM / Snow depth
- GEOS-4 AGCM / Soil moisture
- GEOS-4 AGCM / Surface geopotential
- GEOS-4 AGCM / Surface heat and moisture fluxes
- GEOS-4 AGCM / Surface roughness
- GEOS-4 AGCM / Surface temperature
- GEOS-4 AGCM / Surface temperature change rate
- GEOS-4 AGCM / Surface type
- GEOS-4 AGCM / Total precipital water
- GEOS-4 AGCM / Wind surface stress
- GEOS-4 AGCM / Wind velocity
- GEOS-4 AGCM / Wind velocity change rate



Atmospheric Chemistry

OUTPUTS

- Dust emission
- Optical thickness of individual and total aerosols
- Total aerosol concentration
- Individual aerosol concentration
- 3-D distribution of each aerosol type
- Ozone concentration
- Pressure
- ozone production and loss rates

Model Platforms
- SGI Origin & Power Challenge Cluster
- SGI Origin
- Linux PC
- SunFire 3800 (SPARC)
- SGI Origin and SC45 Compaq Alpha
- Sun/SPARC
- Linux PC (2-processor)
- Grid of 3 128-node Linux machines
- Compaq Alpha
- IBM Workstations
- SGI Altix / Itanium workstations

Program Size: 100,000
Run Time: 3.5 hours/month (4 x 5, full-chemistry simulation on Altix)
Resolution
Temporal: 3 hours
Vertical: 20-55 vertical layers
Horizontal: 2 deg latitude x 2.5 deg longitude until end of 1999; 1 deg x 1 deg afterward
Range
Temporal: 1985-present
Vertical: Surface to 80 km
Horizontal: Global

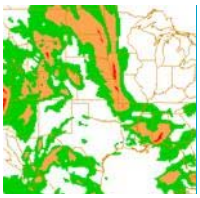
Access to model product: http://www-as.harvard.edu/chemistry/trop/geos/index.html (also <http://www-as.harvard.edu/chemistry/trop/geos/geos_gatekeeper.html> for source code and data files)
Validation: See Bey et al 2001: http://www-as.harvard.edu/chemistry/trop/publications/bey2001a.pdf
Config Control: v7-01-02
POC: Daniel Jacob
Affiliation: Atmospheric Chemistry Modeling Group, Harvard University
Email Address: djacob@fas.harvard.edu
Phone #: 617-495-1794
Funding: NASA
Contract #: NNG04GA56G
Contract Name: Atmospheric Chemistry Modeling and Analysis Program
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: No
Website: http://www-as.harvard.edu/chemistry/trop/geos/index.html
Model Partners
- California Institute of Technology
- Carnegie-Mellon University
- Dalhousie University
- Duke University
- Ecole Polytechnique Federale de Lausanne, Switzerland. Georgia Institute of Technology
- University of Houston
- JPL
- University of L'Aquila, Italy
- University of Leeds, UK
- NOAA
- National Institute of Aerospace
- National Observatory of Athens, Greece
- Princeton University
- University of Tennessee
- University of Toronto
- University of Washington

Notes:The run times depend on which kind of simulation you are performing. The most computationally intensive simulation that you can perform is the NOx-Ox-hydrocarbon-aerosol simulation (aka "full-chemistry" simulation). A "full-chemistry" simulation on the 4 deg lat x 5 deg lon grid takes approximately 3.5 hours/month (SGI Altix). The same run at 2 deg lat x 2.5 deg lon takes about 19 hours/month (also on SGI Altix).

GTG

Purpose:

INPUTS



OUTPUTS

---WAITING ON INPUT---

Model Platforms

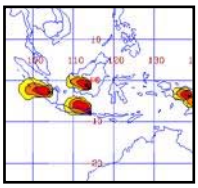
Access to model product:

Hysplit4

Purpose: HYSPLIT4 is a complete system for computing simple trajectories to complex dispersion and deposition simulations using either puff or particle approaches. The model uses previously gridded meteorological data on a conformal or latitude-longitude map projection. Air concentration calculations associate the mass of the pollutant species with the release of either puffs, particles, or a combination of both. The dispersion rate is calculated from the vertical diffusivity profile, wind shear, and horizontal deformation of the wind field. Air concentrations are calculated at a specific grid point for puffs and as cell-average concentrations for particles.

INPUTS

• Meteorological forcing (from atmospheric model, or re-analysis, or obs network, etc.)



Air Trajectories, Pollutant Dispersion, and Deposition

OUTPUTS

•• Individual aerosol concentration
• 3-D distribution of each aerosol type
• pollutant air concentrations and deposition

Model Platforms
- Most UNIX systems or Windows
Program Size: 35,000 lines of code
Run Time: 25 sec on an IBM p630 for one 48-h simulation
Resolution Temporal: 1 minute
Vertical: Particle position in sigma at single precision
Horizontal: Particle position in grid units at single precision
Range
Temporal: User selectable: 1 min to run duration
Vertical: User selectable: 1 m to top of model atmosphere
Horizontal: User selectable: 0.001 deg to 0.5 deg (suggested max)

Access to model product: http://www.arl.noaa.gov/hysplit.html
Validation: Draxler and Hess, 1998, Australian Meteorological Magazine, 47:295-308
Config Control: 4.7
POC: Roland Draxler
Affiliation: NOAA Air Resources Laboratory
Email Address: roland.draxler@noaa.gov
Phone #: 1-301-713-0295 x117
Funding: NOAA
Contract #: No current NASA funding
Contract Name:
Past Funding: NRA 98-OES-13
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: No
Website: http://www.arl.noaa.gov/ready/hysplit4.html
Model Partners

Notes:NASA contract funded development of the ensemble version of HYSPLIT. Current results can be found at http://www.arl.noaa.gov/data/web/ensemble/

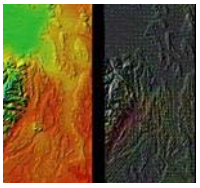
MM5

Purpose: The PSU/NCAR mesoscale model is a limited-area, nonhydrostatic, terrain-following sigma-coordinate model designed to simulate or predict mesoscale and regional-scale atmospheric circulation. It has been developed at Penn State and NCAR as a community mesoscale model and is continuously being improved by contributions from users at several universities and government laboratories.

Model Platforms

INPUTS

- Meteorological forcing (from atmospheric model, or reanalysis, or obs network, etc.)
- skin temperature
- Soil Hydraulic Properties
- Soil Physical properties
- vegetation and soil description
- Radiosonde / Atmospheric Variables
- Temperature Lidar / Temperature
- RUC / Atmospheric/land variables
- NCEP Analysis / Atmospheric/land variables



Mesoscale Meteorology

Acc

Infc

OUTPUTS

- Total aerosol concentration
- 3-D distribution of each aerosol type
- Absorption
- Single scattering albedo
- Radiative forcing
- Heating / Cooling Rates
- Surface geopotential
- Atmospheric temperature
- Sensible heat flux
- Atmospheric pressure
- Precipitation rate
- Total precipital water
- Soil moisture
- Wind surface stress
- Surface temperature
- Geopotential height
- Humidity
- Surface evaporation
- Radiation flux
- Surface albedo
- Friction velocity
- Surface roughness
- Boundary layer height
- Surface temperature change rate
- Snow depth
- Cloud cover
- Cloud optical depth
- Wind velocity change rate
- Humidity change rate
- Eddy diffusivity
- Cloud mass flux
- Atmospheric temperature change rate
- Surface type
- Wind velocity
- Water balance
- surface radiation budget
- Energy balance
- Runoff
- Soil Temperature
- Snow water equivalent
- Latent heat flux
- Ground heat flux
- Evapotranspiration
- Evaporation
- Transpiration
- Infiltration
- Land NPP
- Sea surface temperature
- Surface heat and moistur fluxes
- Water vapor mixing ratio
- Snowfall amount
- Momentum flux

Model Platforms
- IBM
- SUN
- Linux
- SGI
- DEC Alpha
- PC-Intel

Program Size: More than 100,000
Run Time: 25 minutes for 48 hour simulation using parameters in note 1
Resolution
Temporal: Seconds to minutes
Vertical: 500 m
Horizontal: 1 to 150 km
Range
Temporal: hours to years
Vertical: 50 mb
Horizontal: regional (1000's of km) NOTE: some global apps at NCAR

Access to model product: Many available in standard binary output file. Others can be extracted via code modifications.
Validation: Multiple (see http://box.mmm.ucar.edu/mm5/Publications/)
Config Control: Version 3-6-1 (Released March 4, 2003)
POC: NCAR (http://www.mmm.ucar.edu/mm5/support.html)
Affiliation: Mesoscale and Microscale Meteorology Division
Email Address: mesouser@ucar.edu
Phone #: NA
Funding: Multiple Sources (primary NSF)
Contract #:
Contract Name:
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: Yes
Website: http://www.mmm.ucar.edu/mm5/mm5-home.html
Model Partners

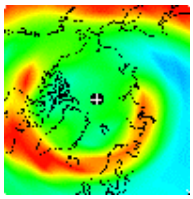
Notes:1. Run time given is for a simulation with a nested configuration (outer domain of 115 x 98 x 27 [y,x,z] grid at 36 km horizontal resolution with a time step of 108 s and a 12 km 73 x 73 x 27 nested inner domain with a time step of 36 s) on a Linux cluster configures with 40 Pentium III 1.0 GHz processors interconnected via a Myrinet fiber optic backbone. More information on MM5 timing can be found at: http://www.mmm.ucar.edu/mm5/mm5v2/mm5v2-timing.html

NCAR TIMEGCM

Purpose: Purpose: Three-dimensional, time-dependent model used to simulate Earth's circulation, temperature, electrodynamics, and compositional structure of the upper atmosphere and ionosphere.

INPUTS

- satellite radiometer / 10 mb ncep lower boundary
- radio antennae / 10.7 cm solar flux
- magnetometer / Kp index



Thermosphere-Ionosphere General Circulation Model

OUTPUTS

- Heating / Cooling Rates
- Atmospheric temperature
- Geopotential height
- Wind velocity
- Water vapor mixing ratio
- o2, o, n4s, noz, no, no2, o3, oh, ho2, h, w, ions, etc.

Model Platforms
- IBM-AIX
- SGI-IRIX64
- GNU Linux

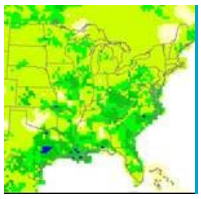
Program Size: 70,000
Run Time: 10 minutes per simulated day (5 minute timestep)
Resolution
Temporal: typically 3-5 minute timestep
Vertical: 0.5 or 0.25 ln(p0/p)
Horizontal: 2.5x2.5 or 5x5 degrees
Range
Temporal: full year runs
Vertical: approx 30-500 km
Horizontal: global

Access to model product: Please contact POC or Ben Foster for history file outputs in netCDF format
Validation: * (see notes below)
Config Control: Version 1 (Version 2 released in Spring 2005)
POC: Ray Roble
Affiliation: NCAR
Email Address: roble@ncar.ucar.edu
Phone #: 303-497-1562
Funding: NASA, National Science Foundation (NSF), Office of Naval Research (ONR)
Contract #: No. S-13, 796-G
Contract Name: Sun-Earth Connection Theory Program
Past Funding:
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: No
Website: http://www.hao.ucar.edu/public/research/tiso/tgcm/tgcm.html
Model Partners

Notes: *See also <http://www.hao.ucar.edu/public/research/tiso/tgcm/tgcm.html> and <http://download.hao.ucar.edu/pub/tgcm/doc/user-guide/> (under construction) Can provide extensive bibliography (e.g., Roble, R.G., et.al.)

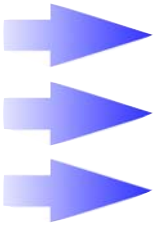
NCVP

Purpose:



INPUTS

OUTPUTS



----WAITING ON INPUT----

Model Platforms

Access to model product:

NCWF

Purpose:

INPUTS

OUTPUTS

---WAITING ON INPUT---

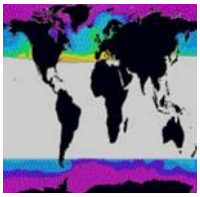
Model Platforms

Access to model product:

RUC

Purpose:

INPUTS



OUTPUTS

----WAITING ON INPUT----

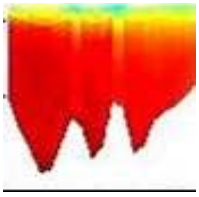
Model Platforms

Access to model product:

SMOKE

Purpose:

INPUTS



OUTPUTS

----WAITING ON INPUT----

Model Platforms

Access to model product:

SWAT

Purpose:

INPUTS

OUTPUTS

----WAITING ON INPUT----

Model Platforms

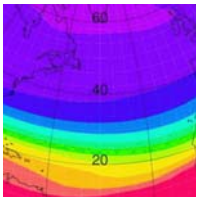
Access to model product:

WACCM

Purpose: The Whole-Atmosphere Community Climate Model (WACCM) is a comprehensive numerical model, spanning the range of altitude from the Earth's surface to the thermosphere. The development of WACCM is an inter-divisional collaboration that unifies certain aspects of the upper atmospheric modeling of HAO, the middle atmosphere modeling of ACD, and the tropospheric modeling of CGD, using the NCAR Community Climate System Model (CCSM) as a common numerical framework.

INPUTS

- aerosol distribution
- Boundary condititions for source gases specified by WMO
- Chemical Kinetics and Photochemical Data from the current JPL evaluation
- SEA SURFACE TEMPERATURES
- solar flux



Dynamics and Chemistry, Surface to Lower Thermosphere

OUTPUTS

- Heating / Cooling Rates
- Surface geopotential
- Atmospheric temperature
- Atmospheric pressure
- Precipitation rate
- Geopotential height
- Humidity
- Cloud cover
- Ozone concentration
- Wind velocity
- Water vapor mixing ratio
- full suite of middle atmosphere chemical species

Model Platforms
- IBM Power-4 cluster, running AIX
Program Size: approx. 25,000 lines (see note 2)
Run Time: approx. 1 day / model year on 96 CPUs (12 nodes x 8 processors)
Resolution
Temporal: 15 minutes
Vertical: variable: 1.3-3 km
Horizontal: 2 x 2.5 degrees
Range
Temporal: annual to century-scale climate simulations
Vertical: 0-140 km approx.
Horizontal: global

Access to model product: NCAR/UCAR Community Data Portal: https://cdp.ucar.edu/
Validation: Use of NASA data for validation purposes: UARS and TIMED satellites
Config Control: waccm1b (noninteractive chemistry) currently available
POC: Rolando Garcia
Affiliation: NCAR/ACD
Email Address: rgarcia@ucar.edu
Phone #: 303 497-1446
Funding: NCAR (NSF)
Contract #: not currently NASA funded
Contract Name:
Past Funding: 2001-2003 NRA-00-01-LWS-059
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: No
Website:
http://www.acd.ucar.edu/science/models/WACCM
Model Partners

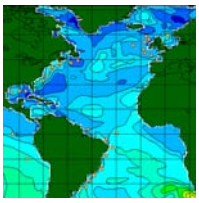
Notes:Note 1: NASA data only used for validation purposes. Note 2: 1.5GB per MPI process, running 12 processes on 8 processor nodes.

WAVEWATCH III

Purpose: This is a generic ocean wave model that runs on nearly all computer architectures. Example applications and source codes can be found at the NOAA/NCEP web site (see below).

INPUTS

- Analyzed / forecasted sea ice products
- Analyzed / forecasted sea surface temperature products
- Analyzed / forecasted surface wind products
- Near-surface wind
- In situ buoys / Wave and wind data
- Altimeter / Wave data
- SAR / Wave spectra



Generic Ocean Wind Wave Model

OUTPUTS

- Significant wave height
- Mean wave length
- Mean wave period
- Mean wave direction
- Sea ice concentration
- Water level
- Peak wave direction
- Peak wave frequency
- Wind sea peak frequency
- Wind sea peak direction
- Mean directional wave energy spread
- Full spectral wave data (at selected output points)

Model Platforms
- UNIX/Linux single processor, OpenMP or MPI
Program Size: 50,000 lines of code, 60% of which is documentation.
Run Time: 30,000 grid point global NCEP model takes 75s per forecast day on 16 IBM power4 processors.
Resolution
Temporal: 1 min to 1 h
Vertical: N/A
Horizontal: 1km to 100 km
Range
Temporal: depends on available forcing only.
Vertical: N/A
Horizontal: Global or regional, depending on resolution

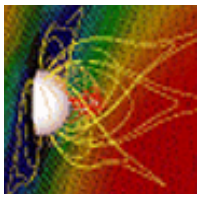
Access to model product:
http://polar.ncep.noaa.gov/waves/products.html
Validation: http://polar.ncep.noaa.gov/waves
Config Control: Version 2.22
POC: Hendrik L. Tolman
Affiliation: SAIC-GSO at NOAA/NCEP
Email Address: Hendrik.Tolman@NOAA.gov
Phone #: 301-763-8133 x 7253
Funding: None
Contract #:
Contract Name:
Past Funding: Previous model WAVEWATCH II NASA funded 1990-1992 (NRC Re. Res. Ass.)
Currently Use NASA Data Products as Input: No
Being Investigated for Use of NASA Data Products as Input: No
Website: http://polar.ncep.noaa.gov/waves/wavewatch
Model Partners

Notes: Due to the nature of the forecast problem, initial conditions are not essential, and hence good forecasts can be achieved without analysis data, provided that the model provides its own initial conditions for continuity, and that it is has spun up for a sufficient period (hours for small scale applications to several weeks for Pacific applications).

BATS-R-US EEG

Purpose:

INPUTS



OUTPUTS

----WAITING ON INPUT----

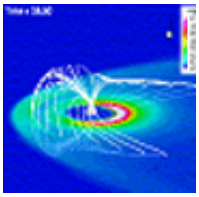
Model Platforms

Access to model product:

BATS-R-US GM

Purpose:

INPUTS



OUTPUTS

----WAITING ON INPUT----

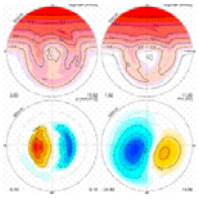
Model Platforms

Access to model product:

BATS-R-US IE

Purpose:

INPUTS



OUTPUTS

---WAITING ON INPUT---

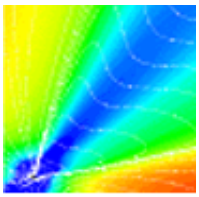
Model Platforms

Access to model product:

BATS-R-US IH

Purpose:

INPUTS



OUTPUTS

---WAITING ON INPUT---

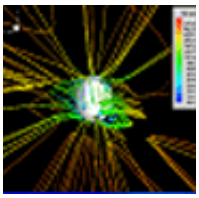
Model Platforms

Access to model product:

BATS-R-US SC

Purpose:

INPUTS



OUTPUTS

----WAITING ON INPUT----

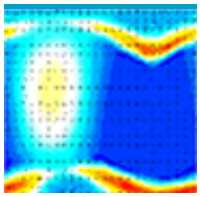
Model Platforms

Access to model product:

GITM

Purpose:

INPUTS



OUTPUTS

---WAITING ON INPUT---

Model Platforms

Access to model product:

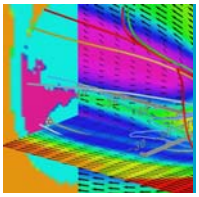
Open GGCM

Open Geospace General Circulation Model

Purpose: The OpenGGCM is a general purpose model of Earth's geospace, covering the regions from the solar wind to the ionosphere and thermosphere. Its primary use is: * investigate physical processes in geospace * help understand and interpret in-situ observations in geospace * predict observations of planned missions and help to optimize observation and orbit strategies * understand and predict geomagnetic activity and space weather

INPUTS

- Solar wind (SW) and interplanetary magnetic field (IMF) parameters, either measured by a monitor, such as Wind or ACE,
  predicted by a solar-heliosphere model, or made-up for parameter studies.
- Solar 10.7 cm flux



Global Magnetohydrodynamic Magnetosphere

OUTPUTS

- magnetosphere 3d fields of MHD variables: magnetic field, electric field, plasma velocity, density, and temperature.
- ionosphere potential, field-aligned currents, Hall/Pedersen conductance, e-precipitation parameters, aurora.
- LEO satellite perturbations (B-field, ion drift).
- ionosphere 3d fields: e- density, temperature, drift, ion composition and thermodynamics, drift.
- thermosphere neutral density, composition, temperature, winds.
- ground magnetic perturbations.

Model Platforms:
IBM SP (Power4/5) systems
Linux IA32 and IA64 clusters
Program Size: 8-1000 compute nodes
Run Time: minutes to days. Can be run in real-time with sufficient resources.
Resolution -Temporal: seconds.
Resolution - Vertical:
magnetosphere: variable, down to ~ 100 km
ionosphere/thermosphere: 20 pressure levels
Resolution -Horizontal: ionosphere/thermosphere: 2 degrees in latitude, 5 degrees in longitude
Range - Vertical:
magnetosphere: [-500,24]x[-40,40]x[-40,40] RE, can be larger if needed. ionosphere/thermosphere: 80-16000 km altitude.
Range -Horizontal: global

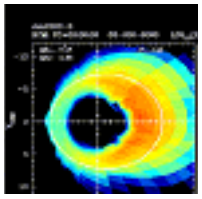
Access to model product: http://openggcm.sr.unh.edu/wiki/index.php/Main_Page, http://ccmc.gsfc.nasa.gov/
Validation: http://openggcm.sr.unh.edu/wiki/index.php/Main_Page
Config Control: subversion
POC: Joachim (Jimmy) Raeder
Affiliation: University of New Hampshire, Department of Physics & Space Science Center
Email Address: J.Raeder@unh.edu
Phone #: 603-862-3412
Funding: NASA and NSF
Contract #: several
Contract Name:
Past Funding: NASA and NSF
Currently Use NASA Data Products as Input: yes
Being Investigated for Use of NASA Data Products as Input:
Website: http://openggcm.sr.unh.edu/wiki/index.php/Main_Page
Model Partners:
- NOAA Space Environment Center (Dr. Tim Fuller-Rowell)\
- Rice University (Dr. Frank Toffoletto, Dr. Anthony Chan)
- GSFC (Dr. Mei-Ching Fok)
- NCAR (Dr. Art Richmond)

RCM

Purpose: First-principles modeling of Earth's inner magnetosphere and coupling to ionosphere

INPUTS

- Dst index
- ground based / magnetometters
- LANL / plasma
- ACE plasma detector / solar wind density and velocity
- ACE magnetometer / solar wind magnetic field
- Hilmer-Voigt / magnetic field model



Inner Magnetosphere

OUTPUTS

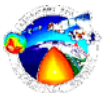
- Ionospheric potential distribution
- Ring current and plasma sheet particle fluxes
- Magnetic-field-aligned current distribution

Model Platforms
- Unix workstation
Program Size: 12,000 lines of code
Run Time: About 1 hr CPU time for 1 hour magnetosphere time
Resolution
Temporal: 10 minutes
Vertical: 0.2 Earth radii (RE) in equatorial plane
Horizontal: 1 RE in equatorial plane
Range
Temporal: 48 hours for typical magnetic storm
Vertical: 10 RE
Horizontal: 20 RE

Access to model product: Access to model product:
Contact S. Sazykin (sazykin@rice.edu),
R. Spiro (spiro@rice.edu), or R. Wolf (rawolf@rice.edu)
Validation: Garner et al., JGR, 109, A02214, 2004
Config Control: Version 2004A
POC: Dr. Richard Wolf
Affiliation: Rice University
Email Address: rawolf@rice.edu
Phone #: 713-348-3308
Funding: NSF, NASA
Contract #: NAG5-11881
Contract Name: Magnetospheric storm dynamics
Past Funding: 1999-2001, NAG5-8136
Currently Use NASA Data Products as Input: Yes
Being Investigated for Use of NASA Data Products as Input: No
Website:
Model Partners

Notes:

Earth Science Laboratories



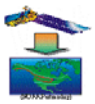
Laboratory for Terrestrial Physics

GSFC Laboratory for Atmospheres

Global Hydrology and Climate Center

Short Term Prediction Research and Transition Center

Community Coordinated Modeling Center

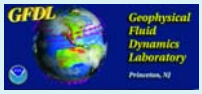


Joint Center for Satellite Data Assimilation

Laboratory for Hydrosphereic Processes

Goddard Institute for Space Studies

Partner Laboratories



Geophysical Fluid Dynamics Laboratory

Los Alamos National Laboratory

Air Resources Laboratory

Office of Research and Applications

Network for Earthquake Engineering Simulation

National Centers for Environmental Prediction

Pacific Northwest National Laboratory

Sandia National Laboratories

Lawrence Livermore National Laboratory

National Center for Atmospheric Research

Suggested Reading

Hill, Chris, Cecelia DeLuca, Balaji, Max Suarez, and Arlindo da Silva, 2004. “The Architecture of the Earth System Modeling Framework”. Computing in Science & Engineering, 6(1):18-28.

Lin, Shian-Jiann, Robert Atlas, and Kao-San Yeh, 2004. “Global Weather Prediction and High-End Computing at NASA”. Computing in Science & Engineering, 6(1):18-28.

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King, Roger L. and Ronald J. Birk, 2004. “Developing Earth System Science Knowledge to Manage Earth's Natural Resources”. Computing in Science & Engineering, 6(1): 45-51.

Science Mission Directorate
Earth Science Division

This booklet is part of a series of three booklets. Please read the Space Observation Systems booklet for more information on the individual missions and the Partner Decision Support Tools booklet for more information on support tools.

These booklets are derived from the **Earth Science Components Knowledge Base which is available on-line at** **http://www.asd.ssc.nasa.gov/m2m**

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